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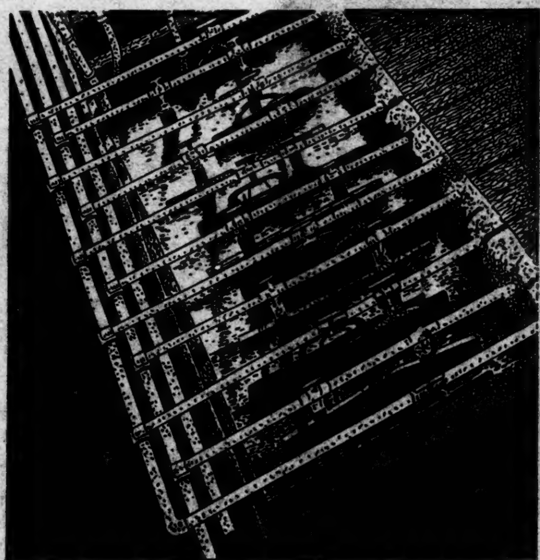
Metals Review

VOLUME XX •• No. 6 **JUNE 1947**

CLEANING AND FINISHING ISSUE



Featuring

Cleaning of Metals
By C. A. Snavely

Metal Finishing
By E. L. Combs

Electroplating
By W. H. Safranek

A series of three articles by members of the electrochemical engineering division of Battelle Memorial Institute, reviewing new developments and new applications as revealed in the technical literature published during the past 18 months.

Equipment for the Finishing Department

149 new products and processes for metal cleaning, rustproofing, coating and electroplating, developed by the manufacturers during the current year—a descriptive "where-to-buy" guide.

NOTABLE LECTURES

Reported This Month

A four-man panel discussion on surface protection of metals covers plating and chemical coatings; galvanizing, tinning and terne coating; vitreous enamel coatings; and organic coatings . . . Robert Kulp cites three basic reasons for use of ferro-alloys in openhearth steelmaking and gives criteria for their selection . . . Chipman and Thum elaborate on theme of Tri-Chapter Meeting—"Metallic Atoms in Action" . . . J. B. Johnson proves that all three major fabrication methods, namely, forging, casting and welding, have a place in the production of airplanes . . . Harry Ihrig demonstrates the part metallurgy played in winning the Battle of Britain by making possible the continuous production of high-octane gasoline . . . John Kimberley predicts increased commercial use of refractory bronzes by dint of continuous casting.

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NEXT MONTH — WELDING, BRAZING, SOLDERING

Metals Review

Vol. XX, No. 6

Published monthly by the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Alfred L. Boegehold, President; Francis B. Foley, Vice-President; William H. Eisenman, Secretary; Harold K. Work, Treasurer; Arthur E. Focke, John E. Dorn, Walter E. Jominy, John Chipman, Trustees; Charles H. Herty, Jr., Past President. Subscriptions $5.00 per year ($6.00 foreign). Single copies $1.00. Entered as Second Class Matter, July 26, 1930, at the Post Office at Cleveland, Ohio, under the Act of March 3, 1879.

June 1947

RAY T. BAYLESS, Publishing Director MARJORIE R. HYSLOP, Editor GEORGE H. LOUGHNER, Production Manager

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AMERICAN SOCIETY FOR METALS

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Cleaning of Metals

By C. A. Snavely

PREDICTIONS are being made that a buyer's market will soon reappear on the American scene. This has a meaning in the cleaning department, just as in all departments whose operating costs add to the unit cost of the firm's product. The hectic days when, to double production, a plant had merely to triple facilities and quadruple the labor force are now practically forgotten. To meet the demands of the future, to remain solvent in a competitive era, the same management must now concentrate on "doing it cheaper" and "doing it better".

The standard cleaning methods and their general and special applications have recently been restated in a concise, highly usable form (7-290, 1945 volume).* The newer developments in cleaning materials and methods can be worked into this background to form the current pattern of cleaning technology.

Evaluation of Cleaners

Two general evaluations may be made in choosing the best available method and material for a given cleaning job. First is the classification of type of soil to be removed; second is the specification of degree of cleanliness required. General classifications for different types of soils or surface coating have been established (7-269, 1945 volume). These include foreign contaminants on the metal surface, and oxidation or other chemical products of the basis metal. In most cases, a few simple laboratory tests will reveal the color of the horse.

The degree of cleanliness required is difficult of definition. Absolutely clean surfaces are not long retained in ordinary industrial practice (8-11, Feb. 1946; 8-53, May 1946), and they are seldom necessary. An adsorbed chemical film or a thin oxide film may often serve as protection and may have no deleterious effect on further processing. A steel part removed from an acid pickle bath and rinsed may suffer superficial oxidation in a matter of seconds. Yet such surfaces are ordinarily satisfactory for electroplating.

Much of the recent interest in cleaners is connected with the search for evaluation methods, but there are several difficult problems of judgment in the development of these test procedures. A first requirement is a standard test-panel soil which reasonably duplicates the soil encountered on the work to be processed. Second, the cleaner should be tested under conditions similar to those of the production line. Third, the method of evaluating the processed test panels should be neither too severe nor too perfunctory.

The shortcomings of the ordinary water break test have provided an impetus for the development of a more elegant version. In the modified test, the water is "fogged" onto the cleaned test panels with a spray gun (7-85, May 1946; 7-181, Aug. 1946). The method appears to provide reproducible results.

Other methods for evaluation of cleanliness are the fluorescent oil under ultraviolet light test (7-216, Sept. 1946), and the immersion copper plate test (7-219, Sept. 1946). However, all of these tests are indirect, and results are difficult to interpret in terms of the degree of cleanliness needed. It appears that a single test that is satisfactory for all cleaners and all soil conditions is yet but a dream.

A general theory for the mechanism of cleaning involves saponification, emulsification, deflocculation, and decreasing interfacial tension. This accepted theory is now challenged by a theory which involves only interfacial tension relationships (7-44, Feb. 1947). The use made of contact angles between air bubble and metal in obtaining these data suggests the possibility of building yet another indirect test for cleaner performance.

A cleaner whose formula includes a magic ingredient to prevent the shop foreman from discarding a cleaning bath before it is exhausted would be well received in the trade. (Perhaps this is in the realm of metaphysical theory, rather than plain physical chemistry.)

Acid Pickling

The question of regenerating acid pickling baths has again come to the fore (7-168, 1945 volume; 7-95, June 1946; 7-134, July 1946; 7-321, Dec. 1946). The de Lattre "balanced action" bath, composed of a mixture of sulphuric and hydrochloric acids, apparently gives greater pickling speeds than sulphuric alone. Regeneration of the acid depends on precipitating ferrous sulphate from the used pickle liquor by cooling to below 20° C. The greatest difficulty in the application of the process lies in the regenerating equipment. At this stage it appears that only a Siberian plant site, where cooling facilities are provided by nature, would be amenable to economical use of the method.

Cleaning With Molten Salts

In the sodium hydride descaling process (7-254, 7-271, and 7-277, 1945 volume; 7-41, March 1946; 7-133, July 1946), a bath of molten caustic is charged with 1.5 to 2.0% of sodium hydride. The bath is maintained between 680 and 720° F. The hydride reduces the scale on the work, leaving only a powdery form of elemental metal as a surface contaminant. This may be blasted off by the steam formed in a water quench. The water also dissolves adhering caustic. A short bright dip in pickling acid is sometimes used as a final treatment.

Advantages of the process are its savings in time and metal. Further, certain stainless steels not amenable to acid pickling may be successfully treated with sodium hydride. Materials and equipment, however, are costly, and expansion of the process into many of the jobs now accomplished by acid pickling is dependent on the economic balance between the two methods.

Calcium hydride and boron hydrides have been adapted to reduction processes other than descaling.

The Kolene No. 4 process is a molten salt method with specialized application in the electrolytic cleaning of cast iron prior to tinning or tin plating (7-22 and 7-78, 1945 volume). Adhesion is superior, and considerable savings in tin have been effected. The chief deterrent to wider use of the process is the cost of materials.

Blast Cleaning

Developments in blast cleaning are mostly in the nature of advances in equipment design. Selection of the correct abrasive for a given job is a subject for frequent re-evaluation (7-47, 1945 volume). It is said that 100 lb. of steel grit will do as much work as 2 tons of Ottawa sand. Aluminum oxide is another synthetic blasting material offering long service life.

The "soft grit" blast cleaning process is the one newcomer in this field (7-225 and 7-287, 1945 volume; 7-27, March 1946; 7-183, Aug. 1946). "Soft grits" are simply ground corn cobs, ground apricot pits, ground walnut hulls, cheap grades of clover seed, or plastic pellets. These materials are used in standard blast cleaning equipment to remove carbon deposits from internal combustion engine parts. Alu-

*Literature references are designated by the corresponding section and item numbers in the "Review of Current Metal Literature" rather than by repeating the entire title, author, and source. Articles appearing in 1946 and 1947 were listed in *Metals Review* for the month indicated; the others are given in Volume II, 1945, assembled from listings of that year.

minum, magnesium, brass and steel parts are not damaged. The process is of use mainly in overhauling aircraft or diesel parts, particularly for piston and cylinder cleaning. Corn cobs, properly prepared, constitute the best soft grit material yet found.

Metal Finishing

By E. L. Combs

IN 1945, E. E. Oathout (7-275, 1945 volume) expressed the opinion that the finishing industry advanced 20 to 50 years in the preceding four years under the impetus of wartime production. This article reviews new developments in electropolishing, anodizing, metal coloring, metal spraying, and hot dipping, with only brief reference to mechanical surface treatments.

Polishing and Buffing

Improvements in wheels, abrasives and methods of application are reviewed in a notable series by Hyler (7-383, 7-393, 7-398, Jan. 1947; 7-8, 7-23, 7-34, Feb. 1947). Better and more uniform abrasives now available have better capillarity and tenacity, and new polishing wheels of resilient material impregnated with abrasives have been developed. Water-soluble coloring rouge is the latest type of buffing compound. Faulhaber (7-184, Aug. 1946) considers surface requirements as factors in selecting the proper abrasive.

Vernon, Wormwell, and Nurse (7-54, 1945 volume) studied the effect of buffing on the surface of 18-8 stainless steel. The surface film containing chromic oxide, ferric oxide, and nickel oxide becomes enriched in buffing when a compound containing chromic oxide is used; the steel becomes more passive, and corrosion resistance is improved.

Abrasive belts as a substitute for hard faced, grit-coated polishing wheels have proven themselves in production, and seven machinery manufacturers build backstand idler pulleys for this purpose (7-275, 1945 volume; 7-250, Oct. 1946). Le Grand indicates the versatility of belt polishing (7-95, 1945 volume).

Practical suggestions for polishing and buffing those little parts which are too few in number to warrant making expensive jigs are offered by Moore (7-141, Aug. 1946). Lapping has become more efficient with the development of a method for grading and suspending virgin diamond powders (7-38, Feb. 1947). The suspending medium clings to the lap and more work can be accomplished with one coat.

Spraying of liquid buffing and polishing compounds on the wheels during operation is described by Siefen (7-335, Dec. 1946; 7-189, Sept. 1946; 7-154, 1945 volume). The operator mechanically applies a thin coat of cold glue and aluminum oxide of the correct grit size to the wheel as needed. Barrel finishing as discussed by Lord (7-364, Jan. 1947), Scotten (7-312, Dec. 1946), Chase (7-121, July 1946), and Allen (7-151, July 1946) has been brought to a high degree of engineering precision. Limestone chips plus special compounds have been adapted to this process.

Electropolishing is now a commercial process for surfacing, machining, or finishing metals, Faust points out (7-370, Jan. 1947). A brilliant surface may be provided or metal may be removed without cold working or heat effects. The method gives a different finish from that provided by the cutting and burnishing action of wheels and tumbling barrels.

Jacquet (7-13, Feb. 1946) describes electropolishing as a "perfect" control process. The method is capable of revealing all heterogeneities resulting from heat treatment or machining, and may therefore be used to control production rejects. Jacquet and Faust agree that finishing installations should not be treated in the same manner as nickel and chromium-plating units. Each unit should be designed for quick adaptation to individual applications.

The close observation of a laboratory worker revealed that silver plate could be electropolished in the silver cyanide plating bath (7-196, Sept. 1946). The plated part is made the anode and an interrupted current applied until maximum luster is obtained. The complete operation takes about a minute.

Metal Coloring

Black coatings became a popular finish during the war, and improvements may help to hold this position in civilian production. Silman (7-125, 1945 volume) stipulates that a black coating for steel should be hard and resistant to wear; corrosion resistant to a high degree and stainproof on handling; cheap to apply; free of corrosive or hygroscopic chemicals, which tend to leach out of crevices in subsequent service; and applicable without elaborate cleaning or pretreatment. Unfortunately, no current process meets all of these requirements and each must be selected for the specific use.

Strassburger (7-99, 1945 volume) describes a blackening process for stainless steel that is truly an oxide and not a hydroxide. A nonaqueous bath operated at moderately high temperature is involved. Schulze (7-69, April 1946 and 7-126, July 1946) discusses the surface preparation required for blackening, and a ferro-ferric oxide coating which will withstand severe deformation and high temperature. Copper and brass parts used in optical instruments require a special black finish that is produced electrolytically (7-131, 1945 volume). The process is said to be inexpensive and foolproof.

According to Rhael and Summers (7-33, Feb. 1947), distinctive shades of the primary colors can be developed to dye anodized aluminum. Anticipating the return to popularity of the antique finishes (bronze, silver, patina), Maher and MacStoker (7-88, May 1946 and 7-228, Sept. 1946) review the formulas used and explain many of the chemical reactions involved.

Anodizing

Use of anodic coatings on aluminum alloys for postwar applications was given impetus by wartime expansion. Cass (7-84, May 1946) gives the European viewpoint of the structure of the oxide films produced by anodizing, while Keller and Edwards (7-288, 1945 volume) discuss American ideas.

In a study of the structure of some anodic films produced by the sulphuric acid process, Hérenguel and Segond (7-30, Feb. 1947) point out that the film may be either homogeneous or composed of a hard layer underneath and a soft layer on top. Alloy composition has much to do with this phenomenon. The soft layer is caused by chemical attack of the film by the electrolyte. This attack is a function of the temperature and acid concentration of the bath and of current density. Copper and silver in the alloy lead to low current density at a given voltage, while zinc and magnesium facilitate the passage of current. When current density is low, chemical attack takes place more easily.

Herwig (7-167, Aug. 1946) reveals that the use of water of zero hardness from which iron, copper, and manganese have been removed by the ion exchange process, greatly reduces staining in hot water sealing of anodized coatings.

The "Cabac" Boeing short-cycle method of anodizing reduces the time required to 20 min. (7-191, 1945 volume). Power consumption is decreased 40% as compared to the American method and 74% as compared to the British. Chromic acid consumption is 54% and 70% less respectively. The oxide film passes Army-Navy salt spray requirements. Slunder and Pray (7-343, Dec. 1946) modified the chromic acid anodizing bath and predict an attractive saving in chromic acid.

A nonelectrolytic chemical process for treating aluminum (7-381, Jan. 1947) provides a tight skin-like coating, which insulates unpainted metal against the most active corrosive environment, and holds organic finishes with more than ordinary tenacity.

Metal Spraying

New applications of metal spray guns are constantly being developed. Ballard (7-111, 1945 volume) claims that sprayed metal coatings are made up of saucer-shaped particles, all but a few of them lying parallel to the base. The coating is a conglomerate of small bodies. Stiles (7-397, Jan. 1947) indicates that at least one metalizing gun is to be found in almost every large engineering factory in Britain.

Adherence has been improved by applying 0.0005 to 0.001 in. of low-carbon steel as an undercoat (7-39, Feb. 1947). Looney (7-397, Jan. 1947) describes a method for homogenizing

alloy coatings by flowing with a flame nozzle, which closely follows the metalizing gun. This homogenization generally penetrates only a few thousandths of an inch.

For high-speed production metalizing a gun using a 3/16-in. wire is said to deposit more metal and use less gas (7-106, June 1946). Coatings may be 0.080 in. thick and 35 lb. of metal may be sprayed in 1.82 hr.

Kunkler (7-165, 1945 volume) reviews the metalizing of parts on a production basis for corrosion prevention, heat resistance, weight saving, better conductivity of electrical parts and longer life. It can also be used to apply a coating which can be tinned to a surface which otherwise could not be soldered. Lockheed Aircraft (7-57, April 1946) salvages spot weld electrodes, preserves master patterns for profiling, restores steel parts that have been overmachined, and reclaims worn or damaged portions of expensive equipment by metalizing. Herb (7-152, 1945 volume) tells how jig members for jet plane assembly were manufactured by metal spraying over a plaster cast, saving many man-hours. Fellom (7-182, 1945 volume) describes the spraying of magnesium with standard equipment and procedures.

In another method of spraying (7-195, 1945 volume) a fine metal powder is surrounded by a flame of blowtorch intensity, which melts the material as it is blown in a fine spray against the surface to be coated. Glass or plastics may also be applied by this method (7-197, Sept. 1946). Thicknesses up to 0.075 in. may be applied and fused. The deposit is well bonded and free of porosity (7-399, Jan. 1947).

Hot Dipping

Metals generally associated with hot dipping are zinc (galvanizing), tin, and terne (lead-tin). Although electrolytic processes have been developed to replace this method, numerous parts are still best finished by dipping. Improvements have been brought about by research in fluxes, bath components, and processing procedure. Aluminum has also been proven adaptable to hot dipping.

Imhoff (7-28, Feb. 1947) published a short review of the effect of lead in galvanizing baths—a subject debated for 25 years. Zinc pots containing lead are more economical to operate because the bath is more fluid. The dross is more easily removed, and the coating is smoother and more lustrous, and slightly more corrosion resistant. For galvanizing wire, the Herman Process described by Hussey (7-2, Feb. 1946) uses an auxiliary spelter tank designed to minimize the human element. This device applies high-purity zinc at the final stage of coating, and provides a space in which excess spelter can drain freely and naturally.

Imhoff (7-204, Sept. 1946) also points to hot air drying instead of a hot plate prior to galvanizing for steel buckets, malleable pipe, and fasteners, as a step that has doubled production. Uniform drying without burning or corrosion is obtained.

Hack, Kondrat, and Zahn (7-25, 1945 volume) discuss hot dipped lead alloy coatings (terne plate) containing approximately 18% tin. Wartime research showed that coatings containing less than 3% tin are adherent, suitable for painting without special preparation and can be fabricated satisfactorily (including deep drawing).

For tinning of cast iron two new fluxes (7-31, Feb. 1947)—namely, fused zinc chloride and sodium chloride, or potassium nitrate and sodium nitrate—promote better adhesion and smoother, more continuous coatings. Steel, hot dip coated with 0.001 in. of aluminum on both sides, has a salt-spray life of 1000 to 2000 hr. (7-190, Sept. 1946). Temperatures up to 900° F. do not discolor this coating.

Electroplating

By W. H. Safranek

New engineering applications of electroplating are numerous and important, although much attention is also being given to decorative and protective plates. Of these two types of application, the engineering uses are growing at a faster pace, both in total output and in variety.

Special-Purpose Chromium Plates

A new kind of chromium structure, supplanting hard, porous, and flash plates, is known as "soft" chromium. Methods for its commercial control were disclosed for the first time by Gardam (8-70, 1945 volume). Practical current efficiencies and wider ranges at very high current densities are now obtained with additions of iron, reduced chromium, or aluminum to the standard chromium bath.

This low-contraction deposit (400 to 500 Brinell as compared to 700 to 1000 for hard chromium) does not exhibit the crack pattern common to hard plates, and was developed to improve the firing characteristics of gun tubes. It also offers protection against corrosion, low surface friction and good wear resistance. Peach proposes covering "soft" with hard chromium to provide a layer with good corrosion resistance and a hard surface for wear resistance (8-89, Sept. 1946). Soft plates are machinable with cutting tools as against the more expensive grinding of hard plates.

Applications for porous chromium, etched to form pockets for lubricant, have continued to expand. Superior results with channel-type porosity for high-speed engines are claimed by Thornton (8-115, 1945). Porous chromium is used for salvaging of engine cylinder barrels or barrel liners, formerly repaired with hard chromium. Chromium-plated cast iron piston rings provide especially good wear and lubrication characteristics against cylinder-wall liners of alloy steel (8-70, July 1946).

The controversy between proponents of thick and thin hard chromium plates has grown less lively. It is generally agreed that thin plates (0.004 in. or less) provide equivalent wear resistance with fewer failures when applied over properly surfaced steel parts. With good control of plate distribution, regrinding after plating is obviated. There is much new documentary evidence that flash plates greatly extend tool life (8-34, April 1946). When plated tools need sharpening or refinishing, they can be easily replated without stripping the original plate.

Thick chromium plates are sometimes necessary for building up worn parts. For severely worn surfaces building up with nickel before chromium plating is preferred (8-16, March 1947). A list of parts plated with hard chromium for wear resistance is given by Hosdowich (8-130, Dec. 1946). Plating over very hard alloy steels is usually avoided, because of lowered impact and fatigue resistance resulting from internal stress; but Ehlers points out that welding of soft metal chips to chromium-plated high speed cutting tools was eliminated by plating over an intermediate nitrided layer or by plating on sintered carbide tools (8-87, 1945 volume).

Parts subject to repeated stress or impact during service should be relieved by heat treatment before as well as after plating. Zapffe and Haslem, who show that the rate of recovery from hydrogen embrittlement during postplating heat treatment is initially rapid but not uniform, reason that the initial heating period results in some gas diffusion from plate to steel until an equilibrium is reached, followed by a slower rate under similar equilibrium conditions (8-128, Dec. 1946).

Hard nickel plates are also used to resist wear, and, according to Hothersall, can increase fatigue strength as well as tensile strength (8-95, 1945 volume). The versatility of nickel and chromium plating is illustrated by the activity of salvage crews during the war (8-124, Dec. 1946).

Electroplated Bearings

Silver, plated with lead and indium, was used extensively in aircraft bearing surfaces during the war. According to Mesle, the silver alloy grid is superior to all other kinds in three out of four vital requisites (8-107, Oct. 1946). Thick silver plates (0.040 to 0.060 in.), produced at high current densities, were annealed before lead plating, for stress relief and controlled grain growth; this heat treatment also insures good adhesion to steel backing. Schaefer claims that annealing is unnecessary even for thick plates (8-132, Dec. 1946). He also states (8-159, Jan. 1947) that thin bearing layers perform better than thick layers; several alloys, as-plated and without machining, can meet these specifications at less cost.

Silver-lead (4% lead) and lead-tin-copper (10% tin and 1 to 3% copper) are especially promising. Direct deposition of thin layers of silver-lead alloy precludes lead segregation at bearing-backing interface, which can result from diffusion heat treatment (8-38, April 1946). Electrodeposited lead, lead-tin alloys, and duplex lead-tin plates are used extensively in England (8-11, 1945 volume). German interest centers on copper-lead alloys (8-21, March 1946).

Electroforming

Since Savage's account (8-14, 1945 volume) of a new fabricating method for musical horn bells, many parts have been produced by electroforming, ranging from radar cavities, piston domes, and heat exchangers to gears, cams, propeller blades, and molds for forming both plastics and metals. By plating over machined, hardened steel, close dimensional tolerances are secured for resonators and tubing. Copper and silver walls are formed with good strength and minimum energy absorption for high-frequency waves. According to Hassell and Jenks, electroforming costs are less than machining costs (8-43, April 1946). Radar parts, electroformed from iron, are described by Bolz (8-157, Jan. 1947) and by Clauser (8-90, Sept. 1946).

Plated Aluminum Alloys

Aluminum is electroplated chiefly for functional engineering purposes rather than decoration and protection, since nickel and chromium plates ordinarily have less corrosion resistance than the base metal. Low-cost consumer items, however, are bright plated on a fairly large scale, and in England alone, millions of square feet of bright plates are applied yearly (8-50, 1945 volume). In this country, preplated aluminum strip is available for fabrication.

Special purposes for plating on aluminum are to provide solderability, conductivity, adherence to vulcanized rubber, and wear resistance. Tin, silver, brass, and chromium, respectively, are used for these purposes. A comprehensive report by Bengston (8-65, June 1946) reviews means of securing good adhesion of plates to aluminum. Although plating over controlled anodized coatings is satisfactory for certain purposes, the effect of the oxide on conductivity precludes its use for many radio, radar, and electrical parts. Zinc is used commercially and almost exclusively for depositing adherent immersion plates. All procedures employ many involved steps and improved methods are being sought (8-116, Nov. 1946).

Plated plastics, like plated aluminum alloys, have some decorative purposes, but engineering achievements are more important. Narcus (8-121, 1945 volume) cites plated plastics for electronic insulators which must be screened against magnetic fields, high-frequency currents, and radium emanation, and radar antenna masts which withstand vibrational stresses better than metals. Phillips believes that smoother surfaces are more economically obtained on molded plastics than on a metal base (8-23, March 1946).

Other examples of plating for special engineering purposes include a new copper-tin alloy plate (10 to 20% tin) as an efficient stop-off against nitriding. As little as 0.00035 in. is an effective barrier (8-63, June 1946). Heavy nickel plates (0.005 to 0.10 in.) have been applied to the inside walls of pipe and tubing for protection against corrosive fluids (8-154, Jan. 1947).



Eugene L. Combs (Left), William H. Safranek, Jr. (Center), and Cloyd A. Snavely (Right), Authors of This Three-Part Article, Are All on the Research Staff, Electrochemical Engineering Division, Battelle Institute

Decorative and Protective Plates

New specifications for bright plates, particularly in the automobile industry, require two to three times prewar thicknesses. Since stressed bright nickel plates are known to crack and have impaired corrosion protection, some new specifications accept only ductile nickel plates on parts subject to impact. This has precipitated a renewed investigation of stress-free bright or easily buffed semi-bright plates.

Diggin (8-73, July 1946) and other proponents of cobalt-nickel deposits believe that this process provides hard (up to 600 Vickers) and essentially stress-free plates that require little or no coloring. Several new processes rely on the oft-proven conclusion that metallurgical hardness may provide good buffability. Mirror-bright plates, hard but stress-free, are a development which can be expected soon.

Solution impurities may have adverse effects on plate properties and Diggin lists several newly recognized examples (8-77, July 1946). Both Diggin and Case (8-116, 1945 volume) outline continuous purification methods. A comprehensive bibliography of testing methods and factors affecting bond failures was directed by Ferguson for the American Electroplater's Society. The final project report defines important differences between adhesive and bond strengths which help to explain causes for bond failures, not entirely a responsibility of the plater (8-160, Jan. 1947).

Two new processes for bright plating copper were announced recently. One is a cyanide-type bath relying on organic brighteners (8-15, March 1947), and the other employs current reversal for 20% of the total plating time. The polishing action produced by the reversed potential improves scratch hiding power and plate distribution (8-23, March 1947). Because the limiting current density is higher, the deposition rate is faster. The process is also used for silver, brass, and other cyanide electrolytes. A bright tertiary copper-tin-zinc alloy plating process was announced (8-33, April 1946).

New control equipment for process standardization and for reducing labor costs is being installed as fast as it is produced. Ashby and Wernick describe some control equipment for use with rectifiers (8-12, Feb. 1947).

Platers constantly seek faster deposition rates in order to reduce overhead and capital investment. New fluoborate and sulphonic acid baths appear to have previously unequalled propensities for high-speed copper plating. Struyk and Carlson report on the copper fluoborate bath (8-106, Oct. 1946) and Carlson and Krane review the zinc fluoborate solution (8-131, 1945 volume).

In the continuous electrotinning of strip, Ireland forecasts a trend toward thicker plate (0.0002 in.) just as soon as shortages are alleviated (23-23, March 1947). The supply of sheet and strip preplated with nickel and chromium is said to be insufficient to meet the demand (8-94, Sept. 1946).

Efficiency of zinc and cadmium as rust preventives is clearly established. "Filming" with chromates produces an improved sacrificial type of coating having a slower corrosion rate, but does not entirely prevent formation of bulky corrosion products. Alloy or composite plates, including zinc or cadmium, are being investigated for this purpose. Wernick reports improved performance with duplex tin-lead coatings (8-44, 1945 volume) and Cuthbert-

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Equipment for the Finishing Department

149 New Products and Processes for Metal Cleaning, Rustproofing, Coating and Plating

THE YEAR'S developments in new and improved equipment for metal cleaning, finishing and electroplating number into the hundreds, and obviously a full description of all of them would require many times the space available here. Some of them, therefore, will be mentioned only briefly, while a few will be described in greater detail. This does not mean that the latter are of greater importance or interest; they are merely selected as typical of what many other manufacturers are doing.

Mechanical production of a fine surface finish by grinding, buffing, and polishing was treated in the March issue of *Metals Review*, pages 12 and 15. To the equipment described there might be added mention of the spray method of applying abrasive compounds to belts and wheels, which offers time and money-saving advantages over stick and bar applications. The process, as described by J. J. Siefen Co. (R-526)*, consists basically in spraying a mixture of cold glue and abrasive to belts and polishing wheels, which are then baked. Liquid composition may also be sprayed directly onto buffs during the buffing operation. Siefen has a new air-operated spray gun for this purpose (R-527) that applies compound at 35 to 40 lb. air pressure. It is operated either by foot pedal for hand application or cam valve on automatic equipment.

Gerell Mfg. Co. (R-528) has introduced a new line of liquid compounds known as Buffspray. They are free-flowing at room temperature, and rate of settling of the abrasive particles is slow, so that clogging of air hoses and spray guns is held to a minimum. Flash point is 450° F., and Buffspray compounds contain no kerosene or other highly volatile thinners. Both tripoli and lime compounds are sufficiently soluble to wash away with hot water.

A newly developed chrome rouge designated as No. 8319 by J. C. Miller Co. (R-529) imparts a high color when used to remove highlights by buffing, prior to enameling or lacquering. Burned chrome spots are rapidly removed, and no cleaning is necessary after buffing. Adhesion of enamel to the buffed surface is greatly improved.

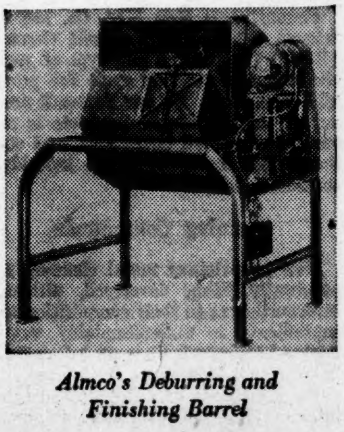
A contour sander made by Sand-O-Flex Corp. (R-530) that can be mounted on a flexible shaft, lathe, or drill press has 12 brush-backed abrasive strips fed from an internal cartridge. Abrasives are available in various grits and grades.

Little new in the field of blast cleaning has been reported, although American Wheelabrator and Equipment Corp. has added a 48-in. swing table (R-531) to its standard line of Tumblasts and tables. It is equipped with a 19½x2½-in. airless Wheelabrator unit, and is designed for cleaning large, bulky, and fragile work that normally requires an airblast room.

New feature of a sandblast machine by Leiman Bros. (R-532) is a combination door and armholes with cuffs which is readily swung open for loading and unloading. Sand is fed through a nozzle and continuously returned by gravity to the sand magazine. The machine is equipped with a tumbling basket for small parts, or the operator can use the armholes to hold and turn large pieces directly under the nozzle.

Tumbling

Grinding, polishing and honing by tumbling metal parts in wet mixtures of mineral chips and compound is a relatively new technique for which equipment and supplies are available from several manufacturers. Sturgis Products Co. calls the process Roto-Finishing, and offers a consulting service to users of its equipment. Most recent is a Roto-Finish midget machine (R-533) for grinding, deburring, polishing, and coloring of small stampings, die castings and parts. Cylinders of this machine are 8 in. wide and 12 in. across the flats. It has a variable speed drive of 35 to 70 r.p.m., and is furnished with or without a base for floor or bench mounting. Britehoning chips (R-534) have been developed to produce a semilustrous finish that is also adaptable as a base finish prior to bright nickel and chromium plating and anodizing.



Almco's Deburring and Finishing Barrel

Vapor Blast Mfg. Co. has developed cabinets for its liquid honing process (R-535) that are equipped with all sorts of mechanical devices—conveyers, turntables, fixtures, belts and tumbling baskets—so that the exact needs of any user can be met. By variations in abrasive, compressed air pressure, nozzle size, abrasive mix, and the water and chemical emulsion, 1000 finish combinations can be produced with one unit.

Almco, Inc., has designed a relatively lightweight, heavy-duty wet tumbler (R-536) to use for deburring and general tumbling, as well as the "Honiting" process. It has a welded steel octagon barrel available in several sizes containing one to five separate compartments measuring from 9½x30 in. up to 60x30 in. An electric screening unit separates the work from the abrasive as it flows from the barrel opening. For the smaller barrels not equipped with the screening unit, Almco has a portable motor-driven shaker screen (R-537) that will serve three or four barrels. Screens are readily interchangeable, and sizes range from 1/16 to 2¼-in. mesh. The screen vibrates in an eliptical path at the rate of 380 reciprocations per min.

Honite—a barrel tumbling material made by Minnesota Mining & Mfg. Co. (R-538)—is a natural abrasive made up of a dispersion of 500 to 600-mesh flint particles. Where a larger amount of metal is to be removed, or where speed is more important than fine finish, Super Honite is recommended. This is a manufactured aluminum oxide grain combined with a softer ceramic bond. Both abrasives are available in a large range of sizes, and are used with Honite Compound No. 1, which acts as a lubricant, rust inhibitor and water softener.

Tumbling balls made of tungsten carbide are being offered by Industrial Tectonics (R-539). They are particularly useful in burnishing and polishing because of their long wear, hardness and corrosion resistance.

Metal Washing Machines

The simplest type of automatic metal washing or cleaning machine is a dip tank in which a tray or rack of parts is slowly raised and lowered in the water or cleaning solution. This type of equipment is exemplified by the new Super-Soak metal parts washer, designed for use with cold solution (R-540). The tray is moved up and down by a lever mechanism operated by a ¼-hp. to 1-hp. electric motor.

*Further information about the products described may be secured by using the Reader Service Coupon on page 55 specifying the appropriate R-number, or by writing direct to the manufacturers at the addresses on p. 15 and 17.

A similar dipping tank made by D. C. Cooper Co. (R-541) has a heavy steel rack with a frame extending above the tank which carries gears, arms fittings, geared motor and cut-off switch. The rack raises and lowers approximately ten times per minute. The tank can be supplied for either cold or hot dipping.

Mabor Co.'s Dip-Agitor (R-542) has its drive mechanism mounted in a removable frame; a knee that rests next to the bottom of the equipment outside of the tank balances the weight of the parts.

The Turco Turbulator tank (R-543), designed for cold cleaning, induces a flow of liquid by compressed air released through tiny orifices into the inner tank.

A screw-drum type of machine that combines washing and drying or rinsing and drying is made by Optimus Equipment Co. (R-544). The drier end is completely enclosed and contains a heater and blower to provide either hot or cold air blast. Mabor Co. has a turn-table type of washer (R-545) that combines rinsing and drying of average-sized parts in baskets, trays, or individually.

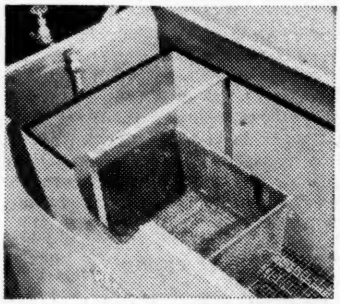
A popular method of degreasing is by solvent vapors, or by combinations of immersion and vapor. A typical machine for such work is Detrex Corp.'s 500-C-1 (R-546), a two-dip immersion vapor degreaser. The machine is conveyerized and permits a choice of any one of several cleaning cycles. Work may be cleaned in hot solvent in the first chamber and moved through vapor in the second. Or it may be submitted to a vapor-immersion-vapor cycle, or a boil-rinse-vapor cycle, depending on the type of soil to be removed. Detrex also has a conveyerized one-dip concentrator called the 1-DC-750 (R-547). Occupying less than 75 sq.ft. of floor space, it is designed to degrease small screw-machine parts.

Mabor Co.'s vapor degreaser (R-548) is equipped with a jacket heating system and a controlled flow of cooling air. It is self-distilling and self-contained, requiring only a plug into power line, and can be rolled into any section of the plant.

Several new models of conveyer-type washing machines have been brought out by Optimus Equipment Co. One is a flat machine (R-549) that processes parts prior to plating in seven consecutive steps, namely: hot alkali wash, drain, hot water rinse, warm cyanide wash, cold rinse to sewer, hot rinse, and dry. The conveyer is built with either flight bars for baskets and individual pieces, or with a mesh belt. Another Optimus flat conveyer-type machine is a spray washer (R-550). In this equipment several solution tanks are arranged in series each equipped with a battery of spray nozzles. Alkaline, acid, solvent, air drying, oil spray and many similar operations can be performed on parts either in baskets, on racks, or laid on the conveyer.

A spray-type machine for the continuous pickling and washing of metal parts prior to enameling or electroplating, or for the removal of scale, is made by B. F. Goodrich Co. (R-551), while Youngstown Welding & Engineering Co. has designed an automatic mechanical pickler that removes scale from 5-ton loads of bars by tumbling or rolling them in the pickling solution (R-552).

At the other end of the scale of sizes a portable steam cleaning unit made by Turco Products weighs only 28 lb. (R-553). It can be connected to any steam line maintaining 80 to 150 lb. pressure, and can be used with a variety of specialized cleaning compounds. The nozzle fits on the end of a long handle equipped with three manual controls to vary the temperature, quantity of solution and nozzle pressure.



Turco Turbulator Tank

Oakite Products' new vapor steam cleaning unit (R-554) may be either stationary or mounted on wheels. It carries an enclosed-coil type, down-draft flame steam generator, and delivers a hot vaporized spray, either wet or dry, at pressures up to 200 lb.

Metal cleaning in the porcelain enameling industry is a specialized problem varying widely in individual plants. Ferro Enamel Corp., therefore, in adding metal-cleaning systems to its enameling products (R-555), decided to make suggestions and recommendations regarding cleaning procedures, chemicals and sequence of operations, and then develop tailor-made cleaners and processes to suit the requirements.

Pennsylvania Salt Mfg. Co. has developed a series of Pennsalt cleaners (R-556) for use in a new type of spray cleaning and pickling cycle for porcelain enameling. No one Pennsalt product or combination of products is recommended for all operations, and each installation must be given individual consideration.

Cleaning Compounds

New proprietary metal cleaners are constantly being developed, although information as to their composition and ingredients is understandably vague. Nielco Laboratories has an informative bulletin (R-557) that compares the various methods of cleaning and tabulates cost of chemicals and equipment.

In the field of alkali cleaners, E. F. Houghton & Co. recently announced an entirely new Houghto-Clean 200 series (R-558) incorporating new synthetic detergents, modern wetting agents and new alkalis. There are 17 cleaners in the series, classed under the five general headings: *(a)* maintenance cleaners; *(b)* cleaners for nonferrous metals; *(c)* special purpose cleaners—salt bath cleaners, paint strippers, cleaners for vitreous enameling and for removing polishing compounds; *(d)* electrolytic cleaners; *(e)* cleaners for ferrous metals in tanks and pressure washers.

Long life of Enthone's new alkali cleaner (R-559) known as Enthone brass cleaner (although applicable to other nonferrous metals as well)is attributed to stable surface-active materials and buffered alkali balance. It has no tarnishing action on active metals, and can be used as a general plating room cleaner. Oakite Composition No. 92 (R-560) is a heavy-duty alkaline detergent specially designed for use in steam guns and coil-type steam generators.

Optimus No. 100 (R-561) is a balanced blend of mild alkaline materials—a white, free-flowing powder, soluble in either hot or cold water. It is used in power-spray washing machines in concentrations of ½ to 2 oz. per gal. and temperatures of 130° F. to boiling. Optimus No. 101A contains special water softening materials and inhibitors for cleaning aluminum. Diversey's new heavy-duty cleaner, free of caustic soda, is known as No. 99 (R-562). It is a free-flowing granular product, intended for use in soak tanks, is practically dustless, will not give off fumes, and is easy on the hands.

Pennsalt's MC-1 (R-563) is a general-purpose cleaner for general maintenance, steam gun and tumble barrel cleaning. It is a dry granular material that forms suds and needs no soap; it will not harm skin or wearing apparel. For aluminum cleaning Pennsalt has introduced A-22, a mild soak-tank cleaner, and A-10 for spray washing (R-564).

Among the emulsifiable solvent cleaners Enthone has developed EC-75 (R-565). Used undiluted, it is self-dispersing and rinses off quickly; carry-over will not harm alkali cleaners. Actusol (Improved) by the DuBois Co. (R-566) can be used as a solvent cleaner, diluted with kerosene, or as an emulsion wash. Oakite Composition No. 98 (R-567) is a self-emulsifying water-mixable solvent designed for use primarily in pressure-spray washing machines for removing light shop dirt and stamping compounds from steel and aluminum. Gaybex Corp. has a ready-to-use emulsifying degreaser known as G-Bex D (R-568).

Magnus 775 parts cleaner (R-569) effectively removes accumulated deposits of carbonized oil, grease and dirt, and can also be used as a paint stripper. It will degrease rapidly at room temperature, but cleaning can

be speeded by heating to 150° F. Turco Transpo (R-570) is a nonflammable cold-tank cleaner with a liquid seal to eliminate odor. Its chief feature is fast action in stripping of carbon, paint, varnish, dirt, oil and grease from engines and parts. Enthone's spot enamel stripper S-45 (R-571) was described in the April issue of *Metals Review*, page 55.

For nickel stripping, the Chemical Corp. has developed Stripode (R-572), to be added to speed up a sulphuric acid strip and protect the base metal. Metclene (R-573), marketed by Biofen Laboratories, is a nonflammable, clear yellow liquid with pH of 2 to 3. It removes rust, grease, oil and dirt in one operation, leaving a rust resistant coating.

An acid pickling agent known as Troxide (R-574) has recently been brought out by Waverly Petroleum Products Co. This is a dry chemical, which, when mixed with water, forms a solution of sulphuric acid. Advantages of the solution over straight acid are that attack on good metal is reduced, no fumes are evolved, hydrogen embrittlement is minimized, and the material is handled in drums rather than carboys.

Use of sodium hydride in conjunction with Ajax electric salt bath furnaces for descaling of castings was described in the April issue of *Metals Review*, page 17. The process is also being used to prepare small and intricately shaped parts for cadmium and chromium plating. For cleaning glass molds a molten salt bath removes deposits of carbonized oil, iron sulphide and oxide without resorting to abrasive methods (R-575). Any production man having such cleaning problems may send a specimen part to the Ajax Metallurgical Service Laboratory; the part will be cleaned without cost to prove the effectiveness of the new methods.

Minimum scaling and simplicity of cleaning is emphasized by Eutectic Welding Alloys Corp. as an advantage of Eutectic low-temperature welding, and instructions for cleaning welds made with various compositions of EutecRod are available upon request (R-576).

Rustproofing and Phosphate Coatings

E. F. Houghton & Co. has simplified its rust preventive line to a series of nine products branded under the Cosmoline series (R-577). Four of these are of the removable thin-film solvent type, one is a nonremovable dielectric variety and four are oil-type films varying in viscosity from a thin oil film to a medium grease consistency.

Freedom-Valvoline Oil Co. has developed a combination fingerprint remover and temporary rust preventive designated as Tectyl 472 (R-578). It is a low-viscosity solvent that forms a transparent film 0.0002 in. thick. It will give indoor protection in storage up to two months. Two new antirust products announced by the Yosemite Chemical Co. are Y-3 Rust Remover and Y-600 Rust Preventive (R-579). The former is a clear, nonoily liquid that removes rust and stain in 3 to 15 min. and gives 10-day protection from further rusting. The Y-600 preventive leaves a microscopically thin film physically combined with the metal.

A large variety of products are manufactured that contain phosphoric acid and are used for cleaning, for a paint base, for rustproofing, or for various combinations of these functions. Typical is a series of four solutions developed by American Chemical Paint Co. The first, known as Deoxidine (R-580), is the standard phosphoric acid metal cleaner and rust remover for use prior to painting. Selection of the appropriate grade depends on the method of application—dip, brush, spray—and the differing accumulations of rust, oil and grease to be removed.

A. C. P.'s Duridine (R-581) is a combined metal cleaner and phosphate-coating chemical. It not only removes oil and grease from rustfree surfaces but also produces a phosphate coating that is a uniform, smooth, thin and tight paint base. A spray process is usually employed with Duridine.

Granodine (R-582) is a chemical used in a spray rustproofing process for sheet steel parts that are to be painted. It produces a smooth, uniform zinc phosphate coating that provides a firm intermediate bond and improves rust resistance of both metal and paint. Thermoil-Granodine (R-583) is a phosphate-coating chemical for imparting high corrosion resistance to iron and steel. When cleaned parts are boiled in it for 10 min. to 1 hr., the surface is transformed into a nonmetallic, nonconductive, dense aggregate of manganese and iron phosphate crystals well integrated with the metal beneath.

Oakite Products, Inc., has several varieties of phosphate conditioning treatments, two of which are described in newly published Service Reports. One is Oakite Compound No. 36 (R-584), a material for simultaneously removing light soils and preparing ferrous metal surfaces for painting. The second is CrysCoat No. 87 (R-585), for pressure-spray washing machines; it cleans, improves paint adhesion, and rustproofs.

Klem Chemical Works' Minit Kote (R-586) is a new product for cleaning and phosphate coating iron and steel parts in a single-stage washing operation, while the Banox process (R-587), developed by Calgon, Inc., provides a flexible, glassy metal phosphate coating from 0.000005 to 0.000015 in. thick that prevents rust between cleaning and painting, and prevents spread of rust from unprotected edges and scratches.

A two-stage process developed by International Rustproof Corp. (R-588) is known as Irco-Izing and Irco-Seal. The former provides a porous zinc phosphate coating, while the latter impregnates and seals the coating. It contains a synthetic resin of heat-setting type as a binder. Since Irco-Seal impregnates rather than coats the surface, there is no appreciable build-up, and small threaded parts that may be clogged if painted are successfully rustproofed. It is offered in a bright metallic color that resembles cadmium plate, as well as in brown, mahogany, blue and black.

Zinc Coatings—Chromating

A zinc chromate primer was developed during the war by Bakelite Corp. and is now being marketed by Brooklyn Varnish Mfg. Co. as Tuf-On P-70 Pri-Met (R-589). This "wash primer" is essentially an alcohol solution of polyvinylbutyral resin incorporating 30 to 50% by weight of phosphoric acid. It is recommended for metals usually considered to have poor paint adherence, such as brass, tin, lead, and cadmium.

Most recent addition to the line of Iridite chromate films is Iridite Bright for providing a lustrous protective finish over zinc and cadmium plate (R-590). (The Iridite division of Rheem Research Products, Inc., has been purchased by the operating management of the company and formed into a new firm known as Allied Research Products, Inc.) Parts are treated by immersing in the solution for only 5 sec., followed by rinsing and drying. Tarnish resistance, as well as appearance, is improved.

Zincilate, manufactured by Industrial Metal Protectives, Inc. (R-591), is a one-coat anticorrosive process recommended for pipe lines, bridges, machine parts, and marine installations. Its galvanic action self-heals a scratch, and it has withstood 1000 hr. exposure in a standard salt spray test—indicative of a service life of 20 years. It may be applied cold by brush, spray gun, and sometimes by dipping, can be air dried in a matter of hours, or in a few minutes if heated to 250° F. It can withstand temperatures up to 600° F.

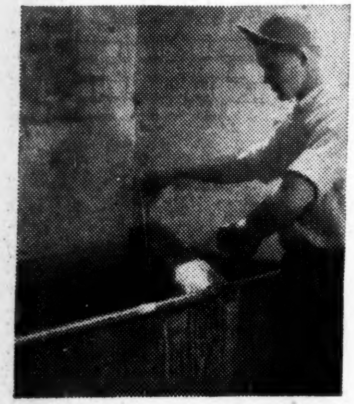
United Chromium's Anozinc (R-592) was developed during the tin shortage and has been widely used on refrigerator shelves. It is applied over a zinc plate in an anodizing bath that forms a yellow conversion coating. Follows a soak in a boiling hot sealing bath that converts the yellow coating to a clear, metallic finish. This is usually followed by a dip coating of a clear synthetic, Unichrome Lacquer B-132 (R-593), especially developed for such conversion-type coatings.

Finishes for Aluminum

Several manufacturers have developed new processes for producing an oxide coating on aluminum by chemical methods. Enthone's Alumox process (R-594) produces a chromate-containing oxide coating that is resistant to salt spray and weathering and forms an excellent paint base. It

is particularly suitable for alloys that do not contain copper; these will show a salt spray resistance of 250 hr. Alumox is applied by immersing in a bath operated at 210° F. for 2 to 15 min. Another Enthone process known as Alumon (R-595) deposits a zinc alloy film that serves as a base for electroplating.

Alodine (R-596), developed by American Chemical Paint Co., is applied at a somewhat lower temperature (about 120° F.) by immersion, spraying, flow coating or tumbling; maximum time required is 2½ min. Adhesion is so good that the metal can be bent flat without damage to the coating.



Rustproofing of Aluminum Tiles With Alodine (Courtesy of Vikon Corp.)

Colonial Alloys Co.'s Chemoxidizing process (R-597) is designed for finishing such aluminum parts as sheets and tubes, assemblies of different alloys, parts with deep recesses and parts with close dimensional tolerance. This company has also developed special solutions, equipment and techniques for color anodizing of aluminum die castings (R-598).

Miscellaneous Protective Coatings

No. 146 Rust Proofing Finish (R-599) made by Mitchell-Bradford Chemical Co. is a liquid that can be applied by dip, spray or brush, and will adhere firmly to all common metals including zinc and aluminum. It is water-displacing and can be applied to freshly rinsed work, leaving a film approximately 0.0003 in. thick. Tests show salt spray resistance up to 50 hr., heat resistance to 500° F., resistance to 50% solution of mineral acids up to 12 hr., and no effect from alkali metal hydroxides and organic solvents.

A black oxide finish on steel is provided by D. C. Oxidizing Compound (R-600), made by D. C. Cooper Co. This is an alkaline salt which is mixed with water and heated. A 5 to 15-min. immersion produces a uniform black finish that will not peel, rub off, crack or chip and is rust resistant. It is recommended for tools, machine parts, screws, and auto parts.

An oxide coloring process known as Blu-Blak (R-601) is applied by immersion for 15 to 60 min. in a bath heated to 250 to 295° F., according to its manufacturer, Protective Coatings, Inc. Blu-Blak penetrates 0.0001 to 0.0004 in., depending upon the hardness of the steel, and colors from the inside out. Watson-Standard's black finish is known as Jetcote (R-602) and comes in a number of variations designed to meet specific requirements of use and method of application.

An aluminum silicate impregnated with hydrocarbons is the foundation for Kaykote (R-603), originated by Kraus Research Laboratories. It adheres strongly to ferrous metal and will withstand a high thermal shock. It may be sprayed or dipped, generally to a thickness of 0.0065 to 0.0013 in. It produces a rust-inhibitive surface that is hard and resistant to abrasion, to acids and to alkalis. It provides a good foundation for shellac, varnish or paint.

A rich oxidized or "antiqued" effect on sterling and silver-plated products is produced by a new solution known as Platin-Nig made by Hanson-Van Winkle-Munning Co. (R-604). The parts are simply immersed in the solution and then highlighted for striking light-and-shadow relief.

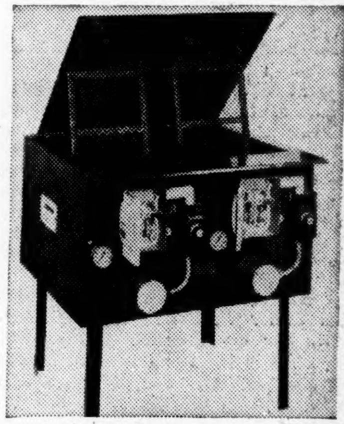
Also in the field of decorative finishes, a new continuous conveyer coating and lithographing oven made by Young Brothers Co. (R-605) incorporates several unusual design features. One is a recuperating zone at the discharge end of the oven which recovers the stored heat in the metal sheets and returns it to the baking zone, thus recovering 30% of the total B.t.u. in an oven baking 3500 sheets per hr. at a temperature of 400° F. Another feature is zone control—to provide the proper heat for various phases of the drying process, each zone of the oven is equipped with individual heating, recirculating, temperature control, ignition and safety equipment.

Burdett infrared gas-fired burners have been put to a new use in a burn-off rustproofing process described for the first time last month (R-606). Degreasing and rustproofing are done simultaneously in about 5 min., replacing such sequences as alkali wash, rinse, chemical rustproofing, and acid bath. (See May *Metals Review*, page 55, for more complete description.)

Enamels, Lacquers and Plastics

Space prohibits anything more than a listing of some of the many new organic and synthetic coatings. Among these, a baking enamel called Polytherm (R-607), which is capable of withstanding temperatures of more than 500° F. without yellowing, was demonstrated for the first time in December by Interchemical Corp. Maas & Waldstein has introduced several new enamels and lacquers in the Britelume, Flashdur and Prismlac line, and has a complete catalog of revised technical data available (R-608). Three other new finishes are Krink-A-Lac (R-609) made by Western States Lacquer Corp.; Hytemp Klearlak (R-610), a product of George R. Mowat Co.; and Lithcote (R-611), marketed by Bedford Development Corp.

Among the synthetic resin finishes are Dy-Nes-Co (R-612, Merchants Chemical Co.), and Metalcote (R-613, American Resinous Chemical Corp.), while a group of finishes combining the resistance of vinyl plastics and the adhesion, depth, gloss and workability of synthetics is being manufactured by Watson-Standard Co. as W-A Vinylite Finishes (R-614). Phenoglaze (R-615), a phenol-formaldehyde coating manufactured in England, is now available



D.C. Oxidizing Installation

in this country from Phenoglaze Sales Corp.

Gel lacquers based on Tenite II (R-616), manufactured by Tennessee Eastman Corp., are applied in a single dipping process and have the appearance and properties of a plastic product, injection molded around a metal core. This simple veneer requires only about one-third as much plastic, however, and eliminates the necessity for expensive molds.

Many of the plastic coatings are manufactured especially for use with electroplating equipment and a large number of so-called "rack coatings" have been introduced during the past year. A vinyl-type coating known as Heilex 445 (R-617) has been perfected by Heil Process Equipment Corp. Effect of temperatures up to boiling is negligible, fitting it to the constant demand for faster and hotter processes. It is also available as a lining for pipe used in transfer of corrosive liquors.

Air Dry Rack Coating 266 (R-618), just announced by U. S. Stoneware Co., provides a thick, resistant coating in two dips. Pen-Kote 590 (R-619, Peninsular Chemical Products Co.) is a nonflammable, odorless Saran-base coating. Nukem Products Corp. has Nukemite (R-620), a synthetic resin coating, and Nukem cement (R-621), a jointing compound for brick pickling and cleaning tanks.

Bunatol 785 is a thermoplastic air-

drying insulation marketed by the Nelson J. Quinn Co. (R-622), as is Miccrotex (R-623), a product of Michigan Chrome and Chemical Co. Goodrich's new Korolac solution RX-2500 (R-624) is accompanied by Korolac Primer No. A-208-B to provide adhesion of the coating to the rack.

New stop-off lacquers include Hanson-Van Winkle-Munning Co.'s Kote-Masq (R-625), United States Rubber Co.'s Kotol (R-626), and a complete line of Chemtite rack enamels and lacquers recently developed by the Maas & Waldstein Co. (R-627). Two spray-booth compounds (materials applied to sidewalls of spray booths so that accumulated paint overspray can be readily peeled off) are Triad PR (R-628), made by Detrex Corp., and Filmite (R-629), made by the DuBois Co.

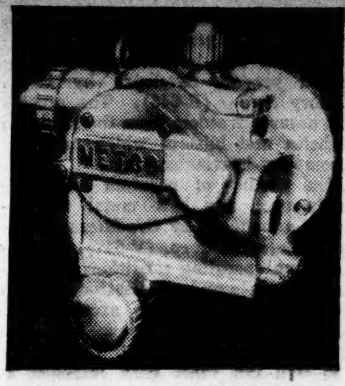
War-developed plastic skin protective coatings that may be simply peeled off are exemplified by Liquid Envelope (R-630), a class of film-forming modified vinyl polymers carried in a volatile vehicle; manufacturer is Better Finishes & Coatings, Inc. Such products have found civilian use in protection of polished sheet, in the forming of stainless steel and nonferrous sheet, in protection of tools in transit and storage, and for stop-off masks in electroplating. Spray-Peel (R-631) is the name of such a strippable plastic recently developed by Eronel Industries. A line of Plast-O-Dip tanks (R-632) has been specially designed by Aeroil Products Co. for applying such coats.

Metal Spraying

The Metco Type Y metallizing gun (R-633), introduced about a year ago by Metallizing Engineering Co., is built for heavy-duty continuous operation without the limitations of size and weight imposed by hand operation. Because the gas head is larger than the heads on hand guns, backfire damage is prevented, and gas balance is maintained easily without increased acetylene pressure. Nonvarying flame and nonvarying wire feed insure uniform density of coatings. Greatly increased spraying speeds are possible with lower gas and oxygen consumption.

A new hand spray gun known as the Forrester alloy sprayer (R-634), recently announced by K. & F. Metal Spray Industries, comes in three sizes —6, 12 and 24 cu.in. melting pot capacity. It is electrically heated and temperature control is adjustable from 100 to 600° F. within 0.1°. Air requirements are 3½ cu.ft. per min. at 30 to 40 lb. pressure.

Metaloy Sprayer Co.'s latest product is a self-contained precision sprayer (R-635) that can be used for either intermittent or production spraying with close control of the amount and characteristics of the spray. The stainless steel melting pot is so designed that intermittent spraying without emptying the pot is possible. Metal is inserted in the pot through the guide ring and feeds down as it melts. The gun may also be fed by ladle and funnel.



Metco Y Gun for Metallizing

A powder, hard facing unit called the Spraywelder developed by Wall Colmonoy Corp. (R-636) combines a metallizing and welding procedure. The gun is used first to apply a uniform overlay of powdered hard facing alloy, and then as a conventional welding torch to fuse this sprayed overlay to the base metal. A somewhat similar principle is utilized in portable equipment by the Glaspray Process Co. (R-637). Finely powdered metal is charged into a pressure pot, and air is blown through, thus carrying a blast of powder into the gun. The powder emerges through the gun's muzzle, surrounded by a ring of flame of blowtorch intensity. By proper air control, flame and powder can be brought together at the point of greatest heat, and melting takes place in mid-air in front of the gun. The process has been used to spray a 0.010-in. thick zinc coating on portions of the Golden Gate Bridge, replacing the five coats of lead and oil paint previously used. The equipment can also be used to spray lead, tin, aluminum, brass and other metals as well.

Electroplating

Two commercial developments in chromium plating are worthy of notice. To eliminate the tendency of hard chromium deposits to chip or flake off, Ductile Chrome Process Co. (R-638) uses an electrolyte which differs from the conventional Sargent's bath in that it is free from sulphate radical and contains a stabilizing material. This bath forms a smoother deposit at greater speed, higher current densities and better efficiency. Higher throwing power permits uniform plating of recessed surfaces. Hardness ranges between Vickers 750 and 950, and the new bath can be applied directly on all steels, including stainless, and on copper, brass, nickel, and zinc.

K. & F. Metal Sprayer

Application of the Porus-Krome process to aluminum has opened up new horizons for engine designers, according to the Van der Horst Corp. (R-639). By providing a hard, wear resisting surface, the process can be used to make cylinders and liners that take advantage of the high thermal conductivity of aluminum.

Light weight, greater power, and improved performance have been proved by comparative tests of a Comet Mark II engine containing first a cast iron cylinder liner and then a Porus-Krome plated aluminum liner. The aluminum sleeve reduced the temperature 175° F. at the hot spot in the head end, and the temperature of the piston behind the top ring was 50° F. lower at full load.

Porus-Krome Plated Aluminum Cylinder Liners

Two new methods of bright copper plating have aroused considerable interest. First is a chemical method known as the MacDermid bright copper plating process (R-640). A simple cyanide copper plating solution is used, according to the standard formula, namely, copper cyanide 6 oz. per gal., potassium cyanide 9 oz. per gal., and caustic potash 2 oz. per gal. Liquid MacDermid Bright Copper Makeup is added to the solution, and the bath is operated normally with 100% efficiency at 140 to 160° F., pH of 13 to 13.5, and current density of 15 to 25 amp. per sq.ft. at 1 to 1.5 volts. Simple steel equipment and any commercial copper anodes may be used. Low-temperature operation and low metal concentration result in low dragout losses, and the bath is highly tolerant to impurities.

The other method of bright copper plating is known as periodic reverse current electroplating and was developed by Westinghouse engineers (R-641). It consists of a cycle in which the plating current is applied for a period of from 2 to 40 sec. to deposit a microscopic increment of metal, and

then the current is reversed for ½ to 5 sec. to remove a portion of the previously plated increment that is unsound or inferior. Repetition of the cycle builds up the desired thickness of plate. The action may be compared to that of a painter who draws his brush back after each stroke to remove excess paint and brush marks.

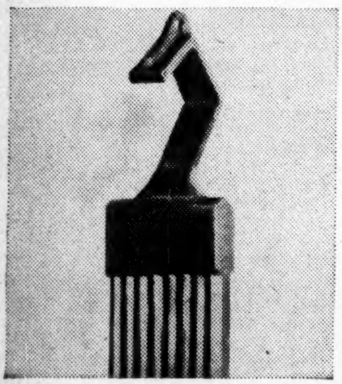
Equipment for the process is under development by Hanson-Van Winkle-Munning Co. (R-642), and various types of plating baths are now being evaluated in the company's laboratories, as well as improved types of control equipment to take care of the rapid reversal of field. Information about this new equipment should be ready for release within a few weeks.

An electro-reversal control unit for bright copper plating has been developed by George L. Nankervis Co. (R-643) which is functioning well in some new installations. It consists of a moisture-proof cabinet, in which are mounted various instruments such as complete timer controls, relays, discharge resistors, and pilot lights to control the output polarity of electroplating motor-generator sets.

Continued research in the deposition of nickel, according to International Nickel Co. (R-644), enables electroplaters to obtain deposits with various physical properties when operating under specific conditions. Nickel can be plated with a hardness of Vickers 140 to 400, tensile strength of 50,000 to 150,000 psi., and ductility of 6 to 30% elongation in 2 in. These developments have aided in the application of heavy deposits in chemical engineering and process industries, for providing hard, corrosion resistant surfaces where both abrasion and chemical attack are factors, and for building up worn or overmachined parts to specified size.

Recent improvements in the Lustrebright nickel process of W. C. Brate Co. (R-645) provide increased operating efficiency. Lustrebright is merely added to cold nickel solution, and provides zinc die castings with a bright nickel deposit that may be chromium plated. Deposits are not streaky and will not peel or become brittle.

In rhodium plating, heavy deposits with the desirable hardness, brilliance, and corrosion resistance inherent in this metal are produced by an improved process developed by P. R. Mallory & Co. (R-646). The process also assures freedom from the shadows, pinholes and blisters which normally accompany heavier coatings.



Heil Massive Lead Anode

The plating of rhenium metal directly upon any base metal was recently announced by Cro-Micron Process & Research Corp. (R-647). Equipment and operating conditions are similar to any standard electrodeposition technique. Rhenium is excellent for acid resistant applications. It has a very high melting point (5400° F.) and will not react with nitrogen at 2000° F.

Plating Machines and Barrels

Latest development of the Udylite Corp. is the Junior fully automatic plating machine (R-648). By use of stressed-skin sheet steel instead of heavy structural shapes, weight, and therefore cost, have been materially reduced without jeopardizing serviceability. The machine uses no conveyer chain, requires no electrical timing control panel or limit switches. Two pneumatic cylinders furnish all the power needed, and the entire unit is manufactured on a mass-production basis with fully interchangeable parts.

A compact electroplating unit introduced by Special Chemicals Corp. as the Specplater (R-649) is a five-tank table 84 in. long and 30 in. wide with rheostats mounted on a frame above, but within convenient working reach. Gas burners for each tank are attached under the table with individual cocks. The tanks are stainless steel or enameled, 12x12x12 in., with handles for easy removal. Anodes are carried into the corners of the tanks.

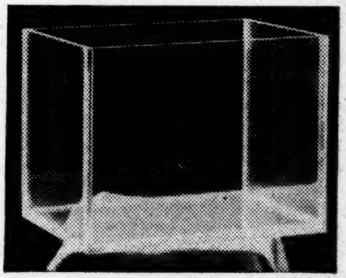
Prefabricated plating plants are shipped knocked down by Unit Process Assemblies, Inc. (R-650) and readily reassembled. They are built in sections to provide any desired combination of tanks. Electrical, gas, water and drain lines are built in the equipment, as well as exhaust systems when required.

Plating plants are now available in single packages from Hanson-Van Winkle-Munning Co. (R-651) for various plating purposes. Typical is equipment for cyanide copper, nickel, gold and silver plating, including a 1500-amp., 6-volt motor-generator set together with tanks, burnishing barrel equipment, polishing and buffing lathe equipment, tank rheostats and miscellaneous supplies.

A plating unit especially designed for the small plant and service shop, known as the Cooper Electro Plater by D. C. Cooper Co. (R-652), is completely self-contained. It contains a circuit of transformers and copper oxide rectifiers which converts 110-volt a.c. to 6-volt d.c. that is applied to cadmium anodes through a heavy copper bus and cable. Anodes are suspended from demountable holders in a welded steel tank 12x24 in. and 15 in. deep.

An intermediate barrel plater built by Lasalco, Inc. (R-653) incorporates several time and labor-saving features. A counterbalancing arrangement facilitates loading and unloading by automatically placing the cylinder in correct position and holding it there by handle and ratchet. A switch-type negative contact works automatically when the cylinder is loaded into the tank.

Use of Lucite acrylic resin for plating barrels has been promoted by E. I. du Pont de Nemours & Co. (R-654), and a hexagonal barrel of this material has been designed by the Hardwood Line Co. (R-655). It is mounted on a



Lucite Plating Tank Designed by Singleton

moving stand which allows the machine, gears and all (also made of Lucite) to be lowered into the solution vat. Singleton Co. (R-656) has been manufacturing Lucite tanks and cells for experimental and small-scale plating. Lucite is chemically resistant to all common plating baths and to common alkalis and acids. It is limited to temperatures below 165° F.; large tanks require an outer container of wood or metal to prevent warpage. Tanks can be custom made to exact dimensions and can be fabricated with slots, ribs or handles.

Anodes and Racks

A new design of lead anode patented by Division Lead Co. as Divco 71-point anode (R-657) has 15.5 sq.in. of surface for each inch of length. Arrangement of the 71 throwing edges concentrates gassing to create a rapid flow of solution against the surface. Deep-ribbed construction prevents warping and buckling.

Another lead anode taller and heavier than a man is especially designed for plating of massive bumpers and grillwork on the postwar automobile (R-658). A product of Heil Process Equipment Corp., it has a patented sawtooth design for better throwing power and current-carrying capacity. Special hooks are provided for hoisting in and out of tanks.

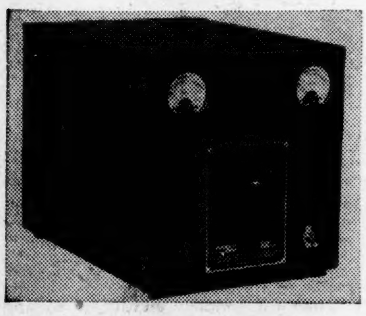
A novel and simple device for preventing loss of chromic acid in a fine spray, loss of heat from the bath, and escape of fumes is called Chrome-Lock plastic tubes (R-659) made by Udylite Corp. Extruded in 3-in. lengths from Dow Chemical Co.'s Styron, they are

closed at each end to resemble miniature pillows. Floated on the plating bath in sufficient depth to form a protective blanket, they easily move apart when a rack of objects is lowered into the solution, and then close back over the rack.

A new design of Specorak plating racks (R-660) made by Special Chemicals Corp. includes cores, spacers, wire holders, wires, nuts and washers for easy assembly into the desired type of rack. They are also sold as complete ready-made racks. Insulated plating racks are made by Duggan Masking Devices (R-661) by molding raw neoprene directly to the metal framework in a hydraulic press with electrically heated platens; advantages are secure bond of the coating to the metal, shock, abrasion, acid, alkali and heat resistance. Rubber insulated tank grids for protection of tank linings and agitation coils against damage are offered by Automotive Rubber Co. (R-662), while Rolock, Inc., designs baskets, trays, crates, racks, fixtures and tanks custom-built for the specific job (R-663).

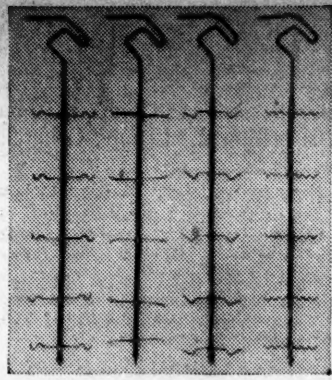
A complete miniature plating laboratory for either routine control of plating solutions or the most exacting research work is known as the Diggin electroplating control table and is made by Hanson-Van Winkle-Munning Co. (R-664). It includes a working table, storage cabinets and drawers, control panel, electric timer, electric and compressed air convenience outlets, six glass cells (three of them resting on hot plates), water taps, shelf for samples, air hose for drying, four Hull cells and four special cells for bent cathode tests.

Plating rectifiers of new and compact design are numerous. Western Gold and Platinum Works has two small, inexpensive selenium rectifiers



Wesgo Selenium Rectifier

of 5 and 15-amp. capacity (R-665) equipped with a variable voltage control, voltmeter, ammeter and overload protection fuses. Similar rectifiers are manufactured by Electro-Tech Equipment Co. (R-666) and Pioneer Rectifier Co. (R-667). Richardson-Allen has added a complete line of selenium rectifiers with tap switch controls (R-668) to their stepless variable-control line, and the new Wagner-Tiedeman rectifier (R-669), described in the March issue of *Metals Review*, page 53, features selenium-on-aluminum cells, aluminum back plates in place of steel, and low-velocity air circulation.



Specorak Plating Racks

Selenium-on-aluminum plates are used in a rectifier stack developed for high current capacity by Radio Receptor Co. (R-670), and a heavy-duty stack featuring double studs, center contact construction and 26-volt plates is now being manufactured by the Federal Telephone and Radio Corp. (R-671).

Dust Control

An article in the April issue of *Metals Review* covering foundry equipment described several installations for dust control and ventilation that are adaptable to cleaning and finishing departments as well as foundries. Mention should also be made of the latest addition to the Roto-Clone series of dust-collecting equipment made by the American Air Filter Co. (R-672), known as the Type N. Air is cleaned by forcing through impeller blades, which create a water curtain in the form of a reverse "S". Having no moving parts, this equipment is safe for the control of magnesium and explosive dusts, the collection of linty and adhesive dusts from buffing operations, and exhaust of corrosive gases.

The Dustex tubular dust collector (R-673) has been developed by Geo. A. Stutz Mfg. Co. for buffing and collection of fine dusts and lint. The tubular filters have a pan at the bottom for collection of the dust and a hand shaker is attached to the unit for cleaning the filters.

The Uni-Wash air supply unit made by Newcomb-Detroit Co. (R-674) is designed for use with paint spray booths. Air is washed twice—first as it passes through a vertical water curtain at the bottom of a central cone and second as it passes through the horizontal curtain formed by the water ricocheting against a disk baffle plate. After passing up through moisture separators, the clean, dry air is reheated by steam coils to the desired temperature. Newcomb-Detroit also now makes its patented water tube spray booth (R-675) as a pre-assembled unit, with only the spray area enclosure shipped "knocked down".

Addresses of Manufacturers

Aeroil Products Co. (R-632)
5701 Park Ave.,
West New York, N. J.

Ajax Electric Co., Inc. (R-575)
Frankford Ave. at Delaware Ave.,
Philadelphia 23, Pa.

Allied Research Products, Inc. (R-590)
4004 East Monument St.,
Baltimore 5, Md.

Almco, Inc. (R-536, 537)
231 East Clark St.,
Albert Lea, Minn.

American Air Filter Co., Inc. (R-672)
First and Central Ave.,
Louisville 8, Ky.

American Chemical Paint Co. (R-580, 581, 582, 583, 596)
Ambler, Pa.

American Resinous Chemical Corp. (R-613)
103 Foster St.,
Peabody, Mass.

American Wheelabrator & Equipment Corp. (R-531)
Mishawaka, Ind.

Automotive Rubber Co., Inc. (R-662)
8621 Epworth Blvd.,
Detroit 4, Mich.

Bedford Development Corp. (R-611)
230 Park Ave.,
New York, N. Y.

Better Finishes & Coatings, Inc. (R-630)
268 Doremus Ave.,
Newark 5, N. J.

Biofen Laboratories (R-573)
14 6th St.,
Bridgeport 7, Conn.

Brate Co., W. C. (R-645)
14 Market St.,
Albany, N. Y.

Brooklyn Varnish Mfg. Co. (R-589)
50 Jay St.,
Brooklyn 1, N. Y.

Burdett Mfg. Co. (R-606)
3433 West Madison St.,
Chicago, Ill.

Calgon, Inc. (R-587)
Pittsburgh, Pa.

Chemical Corp., The (R-572)
54 Waltham Ave.,
Springfield 9, Mass.

Colonial Alloys Co. (R-597, 598)
Technical Processes Div.
Philadelphia 29, Pa.

Cooper Co., D. C. (R-541, 600, 652)
1467 So. Michigan Ave.,
Chicago 5, Ill.

Cro-Micron Process & Research Corp. (R-647)
180 Mulberry St.,
Newark 2, N. J.

Detrex Corp. (R-546, 547, 628)
14331 Woodrow Wilson Ave.,
Detroit 3, Mich.

Diversey Corp. (R-562)
53 West Jackson Blvd.,
Chicago 4, Ill.

Division Lead Co. (R-657)
836 West Kinzie St.,
Chicago 22, Ill.

DuBois Co. (R-566, 629)
1120 West Front St.,
Cincinnati 3, Ohio

Ductile Chrome Process Co. (R-638)
6916 Donald Place,
Detroit 7, Mich.

Duggan Masking Devices (R-661)
2030 West Fort St.,
Detroit 16, Mich.

(Continued on page 17)

A.S.M. Review of Current Metal Literature

An Annotated Survey of Engineering, Scientific and Industrial Journals and Books Here and Abroad, Received in the Library of Battelle Memorial Institute, Columbus, Ohio, During the Past Month.

1 ORES & RAW MATERIALS Production; Beneficiation

1-53. Extraction of Selenium From Ores. I. N. Plaksin, N. A. Suvorovskaia, and A. V. Astafiena. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 7, 1946, p. 668-672. (In Russian.)

The nature of the detrimental effect of selenium upon the cyanidation of gold-bearing selenious ores. Treatment with chloride of lime eliminates the difficulty and also facilitates the separation of selenium from the ores. A flow sheet is proposed.

1-54. The Physico-Chemical Bases for the Hydrometallurgical Concentration of Lead. B. V. Gromov. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 810-819. (In Russian.)

Experiments indicate the feasibility of improving the hydrometallurgical recovery of lead from ores, concentrates, and other materials. 14 ref.

1-55. Chlorination of Tungsten Ores With Liquid Sulphur Chlorides. J. D. Fridman and U. Bogaraz. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 833-840. (In Russian.)

A low-temperature method for recovery of tungsten from its ores. Factors affecting yields, such as chlorine content of the chlorination agent, ore composition, and others. 12 ref.

1-56. Concentration of Ores by Heavy Media. F. T. C. Doughty. *Mine & Quarry Engineering*, v. 13, April 1947, p. 101-107.

Development of heavy-media processes; details of a typical flow sheet, including both theoretical and practical aspects.

1-57. Gold Mining in South India. R. N. Pryor. *Mine & Quarry Engineering*, v. 13, April 1947, p. 111-116.

Present practice and technique. Concentration flow sheet and methods.

1-58. Natural Acidity and Copper Precipitation. Frank Cloke. *Mining Magazine*, v. 76, April 1947, p. 211-212.

Two instances in which insufficient knowledge of the affect of natural acidity on copper precipitation resulted in considerable losses in metallic copper values in copper leaching operations.

1-59. Cassiterite Flotation. (Concluded.) *Mining Magazine*, v. 76, April 1947, p. 247-248.

Use of sulphated and sulphonated paraffin-chain compounds for separation of cassiterite from a Tasmanian quartz ore and from muscovite and wolframite.

1-60. Wartime Treatment of the Lead-Zinc Dumps Situated at Nenthead, Cumberland. E. W. O. Dawson. *Bulletin of the Institution of Mining and Metallurgy*, April 1947, p. 15-24.

The test program and the development of a satisfactory mill circuit.

1-61. Milling on a Shoestring on the African Gold Coast. W. H. Dennis. *Engineering and Mining Journal*, v. 148, May 1947, p. 76-77.

Amalgamation and cyanidation procedures at a Gold Coast mine. Cyanide plant flow sheet.

1-62. Factors in Relative Wear of Grinding Ball Sizes. O. E. B. Timmermans. *Engineering and Mining Journal*, v. 148, May 1947, p. 78-79.

Three tests on balls for a ball mill; effects of variations in feed size, variations in proportion of large to small balls, and using a larger mill.

1-63. Recovery of Copper by Leaching. W. H. Dennis. *Mine & Quarry Engineering*, v. 13, May 1947, p. 140-146.

Dissolving the copper; three principal leaching methods—heap leaching; leaching in tanks and the agitation method; ammonia leaching.

For additional annotations indexed in other sections, see:
23-157; 26-65-67.

2 SMELTING AND REFINING

2-76. Metallothermy and the Electrochemical Series. I. I. Iskoldsky and T. G. Shokhor. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 7, 1946, p. 693-703. (In Russian.)

Attempts were made to apply the thermite reaction to a number of different metal-oxide combinations. Reactions using beryllium and iron, respectively, to reduce oxides, were successful. Metals, intermetallic compounds, and salts are the final products of thermite-type reactions. A relationship exists between the heats of the reduction reactions and the electromotive series. This confirms the ionic character of thermite reactions.

2-77. Electrolytic Separation of Zirconium. V. A. Plotnikov and E. B. Gitman. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 826-832. (In Russian.)

A new method of electrolytic separation of zirconium in coarse-grained powder form. Such zirconium powder may be used in production of zirconium alloys of various compositions.

2-78. Aluminum From a Fused Chloride Bath. Colin G. Fink and Dushyant N. Solanki. *Electrochemical Society Preprint 91-15*, 1947, 15 p.

The problem of a container and of a cathode for melting and electrolyzing a fused mixture of $AlCl_3$ and NaCl. Of the commoner materials tried—porcelain, graphite, porous carbon, iron and nickel—the last was highly satisfactory. Influence of the following factors: the relative proportions of $AlCl_3$ and NaCl; the electrode spacing; the current density at the cathode; bath temperature; duration of electrolysis; added salts; and the substitution of NaCl by other chlorides such as LiCl, KCl and $CaCl_2$.

2-79. Recent Developments on the Preparation of Zirconium. W. C. Lilliendahl and H. C. Rentschler. *Electrochemical Society Preprint 91-16*, 1947, 9 p.

A general survey of contemporary work. Experimental equipment for the production of rare metals in general. A detailed study of the reaction: $ZrO + 2Ca \rightarrow Zr + 2CaO$. The relation of excess reducing agent and addition agents to residual impurities in the metal product, and the effect of these impurities on sintered and melted compacts. By control of the above variables, relatively soft, easily machinable zirconium compacts can be prepared. Some physical properties of the metal.

2-80. Specially Processed Silicon Carbide as a Deoxidizing Agent in the Reducing Slag of Basic Electric Steelmaking. E. A. Loria, H. D. Shephard, and A. P. Thompson. *Electrochemical Society Preprint 91-18*, 1947, 10 p.

The presence of granular silicon carbide in the slag during the finishing period is desirable for it effects the reduction of metallic oxides in the slag and the desulphurization of the bath. Properties of the silicon carbide slag in relation to the ordinarily used calcium carbide and silicon slags. The method of addition and the benefits attained in double slag practice, single slag reduced, and alloy recovery. Ability of silicon carbide to desulphurize the bath is considered from the standpoint of slag volume, fluidity, temperature, and the dissociation of the compounds.

2-81. Recent Developments in Steelmaking. J. A. Kilby and W. G. Cameron. *Transactions of the Institution of Engineers & Shipbuilders in Scotland*, v. 90, March 1947, p. 408-442; discussion, p. 442-448.

An extensive review of British developments illustrated with graphs and tables. 12 ref.

2-82. Vacuum Dezincing in Lead Refining. W. T. Isbell. *Metals Technology*, v. 14, April 1947, T. P. 2138, 4 p.

New high-vacuum technique for removing the 0.5 to 0.6% zinc which remains after desilverization by the Parkes process. The previous process of oxidation in a reverberatory furnace resulted in loss of zinc, and a considerable quantity of lead was converted to oxide in the form of dross and fume.

2-83. Evidence of Formation of Copper Ferrite From Reaction Between Cuprous Oxide and Copper Reverberatory Slags. Pei-yung Huang and Carle R. Hayward. *Metals Technology*, v. 14, April 1947, T. P. 2140, 19 p.

The first experimental evidence of the above phenomenon.

2-84. Effect of Length of Cycle on the Economics of Retort Zinc Smelting. B. M. O'Harra and F. G. McCutcheon. *Metals Technology*, v. 14, April 1947, T. P. 2156, 9 p.

The economics of 24 and 48-hr. cycles as influenced by various factors. Intermediate-length cycles are ruled out because cleaning and recharging would sometimes occur during the heat of the day.

2-85. Copper Phosphide From a Crucible. S. A. Hasik. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 157.

A crucible method for producing copper phosphide, for use as an alloying material in the bronze foundry, from commercial red copper and red phosphorus. (Condensed from *Vestnik Mashinostroenia*, no. 2 and 3, 1946, p. 75-76.)

2-86. Electrical Features of a Modern Hot Metal Mixer Installation. W. A. Mosteller and L. R. Milburn. *Iron and Steel Engineer*, v. 24, April 1947, p. 65-69; discussion, p. 69-70.

The electrical features of a new mixer installed at the Great Lakes Steel Corp. plant in Ecorse, Mich.

2-87. Desulphurization and Dephosphorization of Molten Cupola Iron and Pig Iron in Basic-Lined Ladles. *Foundry Trade Journal*, v. 81, April 3, 1947, p. 259-267.

Recent experience with the desulphurization of molten metal in the ladle using soda ash. Experimental

(Turn to page 18)

Metal Finishing Equipment Manufacturers

(Continued from page 15)

Du Pont de Nemours & Co., E. I.
Wilmington 98, Del. (R-654)

Electro-Tech Equipment Co. (R-666)
119 Lafayette St.,
New York 13, N. Y.

Enthone, Inc. (R-559, 565, 571, 594, 595)
442 Elm St.,
New Haven, Conn.

Eronel Industries (R-631)
5714 West Pico Blvd.,
Los Angeles, Calif.

Eutectic Welding Alloys Corp. (R-576)
40 Worth St.,
New York 13, N. Y.

Federal Telephone and Radio Corp.
Newark, N. J. (R-671)

Ferro Enamel Corp. (R-555)
Cleveland 5, Ohio

Freedom-Valvoline Oil Co. (R-578)
Freedom, Pa.

Gaybex Corp. (R-568)
Nutley 10, N. J.

Gerell Mfg. Co. (R-528)
120 North Maple St.,
Elyria, Ohio

Glaspray Process Co. (R-637)
San Francisco, Calif.

Goodrich Co., B. F. (R-551, 624)
Akron, Ohio

Hanson-Van Winkle-Munning Co.
(R-604, 625, 642, 651, 664)
Matawan, N. J.

Hardwood Line Co. (R-655)
Chicago, Ill.

Heil Process Equipment Corp.
12901 Elmwood Ave., (R-617, 658)
Cleveland, Ohio

Houghton & Co., E. F.
303 West Lehigh Ave., (R-558, 577)
Philadelphia 33, Pa.

Industrial Metal Protectives, Inc.
137 N. Perry St., (R-591)
Dayton 2, Ohio

Industrial Tectonics (R-539)
Ann Arbor, Mich.

Interchemical Corp. (R-607)
Finishes Division,
350 Fifth Ave.,
New York 1, N. Y.

International Nickel Co., Inc. (R-644)
67 Wall St.,
New York 5, N. Y.

International Rustproof Corp. (R-588)
12507 Plover Ave.,
Cleveland 7, Ohio

K. & F. Metal Spray Industries
11204 Charlevoix Ave., (R-634)
Dept. GG,
Detroit 14, Mich.

Kaykote Division, (R-603)
Kraus Research Laboratories
Sparks, Md.

Klem Chemical Works (R-586)
14401 Lanson Ave.,
Dearborn, Mich.

Lasalco, Inc., (R-653)
St. Louis, Mo.

Leiman Bros., Inc. (R-532)
125 Christie St.,
Newark 5, N. J.

Maas & Waldstein Co. (R-608, 627)
438 Riverside Ave.,
Newark 4, N. J.

Mabor Co. (R-542, 545, 548)
Clark Township,
Rahway, N. J.

MacDermid, Inc. (R-640)
Waterbury 88, Conn.

Magnus Chemical Co. (R-569)
Garwood, N. J.

Mallory & Co., Inc., P. R. (R-646)
Indianapolis 6, Ind.

Merchants Chemical Co. (R-612)
Elm Court, Stamford, Conn.

Metallizing Engineering Co., Inc.
38-14 30th St., (R-633)
Long Island City 1, N. Y.

Metaloy Sprayer Co. (R-635)
135 Liberty St.,
New York 6, N. Y.

Michigan Chrome & Chemical Co.
6340 E. Jefferson Ave., (R-623)
Detroit 7, Mich.

Miller Co., J. C. (R-529)
Grand Rapids, Mich.

Minnesota Mining & Mfg. Co. (R-538)
900 Fauquier Ave.,
St. Paul 6, Minn.

Mitchell-Bradford Chemical Co.,
2446 Main St., (R-599)
Stratford P. O.,
Bridgeport, Conn.

Mowat Co., George R. (R-610)
24 West 40th St.,
New York 18, N. Y.

Nankervis Co., George L. (R-643)
5442 Second Blvd.,
Detroit 2, Mich.

Newcomb-Detroit Co. (R-674, 675)
5741 Russell St.,
Detroit 11, Mich.

Nielco Laboratories (R-557)
19720 Florence Rd.,
Detroit 19, Mich.

Nukem Products Corp. (R-620, 621)
Buffalo, N. Y.

Oakite Products, Inc. (R-554, 560, 567, 584, 585)
40 Thames St.,
New York 6, N. Y.

Optimus Detergents Co. (R-561)
106 Water St.,
Matawan, N. J.

Optimus Equipment Co.
173 Church St., (R-544, 549, 550)
Matawan, N. J.

Peninsular Chemical Products Co.
Van Dyke, Mich. (R-619)

Pennsylvania Salt Mfg. Co. (R-556, 563, 564)
Special Chemicals Div.
1000 Widener Bldg.,
Philadelphia 7, Pa.

Phenoglaze Sales Corp. (R-615)
315 Broadway,
New York 7, N. Y.

Pioneer Rectifier Co. (R-667)
120 Cedar St.,
New York 6, N. Y.

Protective Coatings, Inc. (R-601)
Detroit 27, Mich.

Quinn Co., Nelson J. (R-622)
Toledo 7, Ohio

Radio Receptor Co., Inc. (R-670)
251 West 19th St.,
New York 11, N. Y.

Rheem Research Products, Inc.
(See Allied Research Products, Inc.)

Richardson-Allen Corp. (R-668)
New York, N. Y.

Rolock, Inc. (R-663)
Fairfield, Conn.

Sand-O-Flex Corp. (R-530)
4373 Melrose Ave.,
Los Angeles 27, Calif.

Siefen Co., J. H. (R-526, 527)
5657 Lauderdale St.,
Detroit, Mich.

Singleton Co. (R-656)
9823 Lorain Ave.,
Cleveland 2, Ohio

Special Chemicals Co. (R-649, 660)
30 Irving Place,
New York 3, N. Y.

Sturgis Products Co. (R-533, 534)
Sturgis, Mich.

Stutz Mfg. Co., George A. (R-673)
1645 West Carroll Ave.,
Chicago 12, Ill.

Super-Soak Co. (R-540)
1441 South 65th St.,
West Allis 14, Wis.

Tennessee Eastman Corp. (R-616)
Kingsport, Tenn.

Turco Products, Inc. (R-543, 553, 570)
6135 South Central Ave.,
Los Angeles 1, Calif.

Udylite Corp. (R-648, 659)
1651 East Grand Blvd.,
Detroit 11, Mich.

Unit Process Assemblies, Inc. (R-650)
75 East 4th St.,
New York 3, N. Y.

United Chromium, Inc. (R-592, 593)
51 East 42nd St.,
New York, N. Y.

United States Rubber Co. (R-626)
Naugatuck Chemical Div.,
1230 Ave. of the Americas,
New York 20, N. Y.

United States Stoneware Co. (R-618)
Akron 9, Ohio

Van Der Horst Corp. of America
Olean, N. Y. (R-639)

Vapor Blast Mfg. Co. (R-535)
333 So. 16th St.,
Milwaukee 3, Wis.

Wagner Brothers, Inc. (R-669)
421 Midland Ave.,
Detroit 3, Mich.

Wall Colmonoy Corp. (R-636)
19345 John R St.,
Detroit 3, Mich.

Watson-Standard Co. (R-602, 614)
225 Galveston Ave.,
Pittsburgh 12, Pa.

Waverly Petroleum Products Co.
Drexel Bldg., (R-574)
Philadelphia 6, Pa.

Western Gold & Platinum Works
589 Bryant St., (R-665)
San Francisco, Calif.

Western States Lacquer Corp. (R-609)
5000 East Washington Blvd.,
Los Angeles 23, Calif.

Westinghouse Electric Corp. (R-641)
306 Fourth Ave.,
Pittsburgh 30, Pa.

Yosemite Chemical Co. (R-579)
1040 Mariposa St.,
San Francisco, Calif.

Young Brothers Co. (R-605)
Detroit 7, Mich.

Youngstown Welding & Engineering Co. (R-552)
Youngstown, Ohio

work on ladle treatment to obtain dephosphorization.

2-88. Steelmakers Weigh Oxygen Possibilities. *Iron Age,* v. 159, May 1, 1947, p. 50-53, 133.

A.I.M.E. openhearth and blast furnace conference highlighted by discussion of oxygen use for combustion and carbon reduction. High top pressures, raw materials, refractory improvements. An abstract of McKune award paper, "Direct Oxidation".

2-89. Adapts Pilot Plant to Manufacture of Alloy Steel. W. W. Stephens and J. L. Morning. *Steel,* v. 120, May 5, 1947, p. 116, 119-120, 122.

Low-cost power generated at Shasta Dam, Calif., is utilized to test recently developed techniques for economical production of special alloy steels utilizing iron, chromium, manganese, and nickel ores found on the West Coast.

2-90. Steelmaking. R. H. Pullen. *Iron and Steel,* v. 20, April 1947, p. 129-131.

Practice in fixed-type basic openhearth furnaces discussed under headings of *(a)* charging and subsequent melting of the charge, *(b)* refining the charge, and *(c)* tapping the refined steel.

2-91. German Production Methods. *Iron and Steel,* v. 20, April 1947, p. 139-141.

Wartime practice in the manufacture of sheet and plate, including the alloy situation, especially as applied to rolled armor plate. The successful use of low-grade German ores, potentially makes Germany independent in this raw material. Efforts to upgrade basic converter steel especially for use as cold rolled sheets. Factors in German markets and labor rates which retarded the installation of high-production mills for plates and sheets.

For additional annotations indexed in other sections, see:
3-140; **10**-83; **12**-78; **16**-61; **19**-151; **21**-46.

3 PROPERTIES OF METALS AND ALLOYS

3-115. Cohesive Strength and the Creep of Copper and Monel. *Metallurgia,* v. 35, March 1947, p. 234, 238.

Letter from D. J. McAdam, Jr., of the U. S. National Bureau of Standards criticizes E. Voce's review of the literature in "Copper and Copper Alloys," published in December 1946 issue, especially as regards a paper by McAdam, Geil, and Woodard. Mr. Voce's reply.

3-116. The Development of a High Creep Strength Austenitic Steel for Gas Turbines. D. A. Oliver and G. T. Harris. *Metallurgia,* v. 35, March 1947, p. 235-238.

Some of the development work on turbine disk and blade problems, particularly the development of G.18B.

3-117. The Deformation of the Tin-Base Bearing Alloys by Heating and Cooling. W. Boas and R. W. K. Honeycombe. *Journal of the Institute of Metals,* v. 73, March 1947, p. 433-444.

Deformation of some tin-base alloys by cyclic thermal treatment. A comparison is made of tin-base and lead-base bearings on cyclic thermal treatment, and it is shown that the phenomenon is absent in alloys based on the cubic metal lead. The significance of these results as applied to bearing practice and some general metallurgical implications.

3-118. The Mechanical Properties of Some Extruded Zinc-Base Alloys. A. S. Kenneford. *Journal of the Institute of Metals,* v. 73, March 1947, p. 445-470.

Effects of additions of aluminum and copper with or without small amounts of magnesium, manganese, nickel, lithium, and silver on the mechanical properties of experimentally extruded high-purity zinc. Additions of cadmium, antimony, silicon, and bismuth were detrimental or without effect. Small amounts of nickel and manganese gave improved strength with some loss of ductility; silver had a similar effect but caused no loss of ductility. Other observations.

3-119. Carbon-Molybdenum Steel for Steam Pipes. L. Rotherham. *Alloy Metals Review,* v. 5, March 1947, p. 2-5.

The properties of carbon-molybdenum steel which make it suitable for high-temperature steam service correlated from a study of the available literature. The information discussed under the following headings: high-temperature service requirements; creep resistance; ductility; service failures; stability.

3-120. Cementation de Certains Alliages Sidérurgiques par le Glucinium. (Cementation of Certain Ferrous Alloys With Beryllium.) Joseph Laissus. *Comptes Rendus,* v. 224, March 10, 1947, p. 742-743.

Beryllium was investigated as a cementation agent for stainless steels containing 13% Cr and for austenitic 18-8 steels. Included in the study were mechanism of diffusion and influence of time and temperature on hardness of the product. Initial hardness of both alloys was about 195 kg. per sq. mm. The treatment increased it to 642 kg. per sq. mm. for 13% Cr stainless, and to 772 kg. per sq. mm. for 18-8.

3-121. Wear of Splined Shafts. S. H. Frederick. *Machinery (London),* v. 70, March 20, 1947, p. 289-290.

How and why wear takes place in air turbine driving units.

3-122. Resistance of Contact Between Metals, and Between Metals and Carbon Materials. Yu. V. Baimkoff. *Engineers' Digest (American Edition),* v. 4, April 1947, p. 164.

The effects of pressure and of heating to 300° C. for 120 hr. on 21 different contact material combinations. The results are in tabular form. The information is of special value for electrochemical and electrometallurgical plants. (Condensed from 3rd Technical-Scientific Conference of the Kalinin Polytechnic Institute, Leningrad, Russia, Sept. 1944, p. 50.)

3-123. New Strong, Nonmagnetic Spring Material Has High Corrosion Resistance. *Materials & Methods,* v. 25, April 1947, p. 94-95.

Elgin watch-spring material is strong, relatively hard, nonmagnetic, highly resistant to corrosion, nonsetting, and otherwise superior to high quality carbon steel spring materials. Comparison of the properties of Elgiloy with those of the carbon steel spring material.

3-124. Elastic Limits and Permanent Set in Springs. Part II. *Mainspring,* v. 11, April 1947, p. 2-5.

Properties of commercial steel springs which are not hardened, and of the many nonferrous spring materials.

3-125. Copper-Manganese-Zinc Alloys—Physical Properties of Wrought Copper-Rich Alloys. R. S. Dean, J. R. Long, and T. R. Graham. *Metals Technology,* v. 14, April 1947, T. P. 2183, 13 p.

One phase of the Bureau of Mines program on electrolytic manganese included a general review of the system and the establishment of the physical properties of copper-manganese-zinc alloys, using electrolytic manganese, with particular emphasis on compositions within the alpha solid-solution area. The present report is a summary of the tensile properties of wrought alloys in the form of sheet and rod stock for one condition of cold work and one annealing temperature.

3-126. An Investigation of a Thermal Ice-Prevention System for a Cargo Airplane. Part VIII. Metallurgical Examination of the Wing Leading-Edge Structure After 225 Hours of Flight Operation of the Thermal System. Maxwell Harris and Bernard A. Schlaff. *National Advisory Committee for Aeronautics Technical Note no. 1235,* April 1947, 9 p.

Specimens of Alclad 24S-T aluminum alloy sheet taken from the thermal system were examined for the extent of corrosion and for changes in tensile strength as a result of aging of the aluminum alloy by the elevated temperatures. Examination indicated only minor corrosion and no impairment of tensile strength. 15 ref.

3-127. De Ontwikkeling Van De Kruipvaste Staalsoorten. (**Development of Heat Resistant Steels.**) A. J. Zuithoff. *Metalen,* v. 1, April 1947, p. 133-138.

The development of various heat resistant steels with special attention to the improvement in strength at high temperatures during the past five years of alloys for turbosuperchargers and aircraft gas turbines.

3-128. Temper Brittleness in Alloy Steels. *Engineer,* v. 183, April 4, 1947, p. 286-287.

A critical review of several papers. Major attention is devoted to A.S.M.'s 1946 Preprint no. 16 by Pellini and Queneau, "Development of Temper Brittleness in Alloy Steels."

3-129. Precipitation Hardening. Part II. L. Sanderson. *Chemical Age,* v. 56, April 5, 1947, p. 412-414.

Modifications occurring in electrical conductivity and magnetic properties of alloys when precipitation takes place, and the effect of aging on physical properties. (To be continued.)

3-130. Lead-Base Babbitt Alloys. Part I. Physical and Corrosion Properties. Henry P. George. *Product Engineering,* v. 18, May 1947, p. 118-121.

Mechanical and corrosion properties of ten typical lead-base babbitt alloys are compared to those of a standard tin-base alloy. Values for hardness, compressive strength, resistance to distortion under impact, and creep resistance. Typical microstructures. Corrosion rates in acidified oil.

3-131. Influenza delle Impurita Normali (Cu, Zn, Ti) sulle Caratteristiche dell' Aluminio per Uso Elettrico. (Influence of the Normal Impurities (Cu, Zn, Ti) on the Properties of Aluminum for Electrical Uses.) C. Panseri and M. Monticelli. *Alluminio,* v. 15, Jan-Feb. 1947, p. 5-12.

Three series of aluminum wires having varying percentages of impurities were tested, and it was found that titanium decreased the electrical conductivity of aluminum more than copper or zinc. Copper had the greatest effect on mechanical properties.

3-132. The Relationship Between Fatigue and Stress Concentration. R. B. Heywood. *Aircraft Engineering,* v. 19, March 1947, p. 81-84.

Sensitivity index is commonly used to relate fatigue stress-concentration factor to elastic stress concentration. A simpler hypothesis is claimed to be a more reliable guide to fatigue behavior in notches. It assumes that elastic stress-concentration factor gives the reduction in the fatigue strength due to the notch, but because of the local nature of the stress concentration, the endurance limit is increased according to a simple law. This increase in the fatigue strength depends on the smallness of the notch. 15 ref.

3-133. Forming Dies. *Automobile Engineer,* v. 37, April 1947, p. 139-140.

Properties and applications of the zinc-base alloy, Kirksite.

3-134. Temperature Dependence of Magnetic Susceptibility of Annealed and Cold Worked Copper. T. S. Hutchison and J. Reekie. *Nature,* v. 159, April 19, 1947, p. 537-538.

(Turn to page 20)

A.S.M. Nominates National Officers for 1947-48

E. G. Mahin
for Trustee

H. K. Work
for Vice-President

F. B. Foley
for President

E. L. Spanagel
for Treasurer

C. M. Carmichael
for Trustee

Francis B. Foley, superintendent of research for the Midvale Co., Philadelphia, has been nominated for president of the American Society for Metals, to serve for one year starting next fall. At the same time Harold K. Work, manager of research and development of the Jones and Laughlin Steel Corp., Pittsburgh, has been nominated for a one-year term as vice-president, and E. L. Spanagel, engineer in the industrial department of Rochester Gas and Electric Corp., for a two-year term as treasurer. Two new nominees to the board of trustees, to serve for two years each, are E. G. Mahin, head of the department of metallurgy at University of Notre Dame, and C. M. Carmichael, vice-president, Shawinigan Chemicals, Ltd., Stainless Steel and Alloys Division, Montreal.

Selections were made by the National Nominating Committee, meeting in Chicago on May 20. The constitution of the society provides that additional nominations may be made by written communications addressed to the secretary of the society and signed by any 50 members. If no such additional nominations are received prior to July 15, nominations shall be closed and the secretary, at the next annual meeting in the fall, shall cast the unanimous vote of all members for the candidates named by the Nominating Committee.

Francis Foley, who served as vice-president of the society during the past year, was graduated from Girard College and started with Midvale Co. in 1905. He remained on the research staff there until 1917, then successively taught metallography at University of Minnesota, did research at the Bureau of Mines, and was metallurgist for the Lucey Mfg. Corp. In 1926 he returned to Midvale as superintendent of research. He is a past chairman of the Philadelphia Chapter.

H. K. Work, the new vice-presidential nominee, has been with Jones & Laughlin since 1936, following various periods as a research fellow at Mellon Institute, division head of the Aluminum Research Laboratories, and chemical engineer with the Aluminum Co. of America. He has A.B. and Ch.E. degrees from Columbia (1923 and 1925), and Ph.D. from University of Pittsburgh (1929). For the past two years Dr. Work has been national treasurer of the A.S.M.

Edmund L. Spanagel, named for treasurer, is a University of Michigan graduate in electrical engineering. He was employed by Rochester Gas and Electric Co. in 1919, and has been with the company ever since, as engineer of the industrial department. He has long been active in the administration of the Rochester Chapter, serving successively as assistant secretary, secretary-treasurer, vice-chairman, and chairman.

E. G. Mahin and C. M. Carmichael, the two nominees for trustee, will succeed W. E. Jominy and John Chipman, whose terms of office expire in the fall.

Dr. Mahin was graduated from Purdue University in 1908 with B.S. and M.S. degrees, and later added a Ph.D. from Johns Hopkins University. He taught metallurgy at Purdue until 1925, when he came to University of Notre Dame, being made head of the department in 1932. He is a past chairman of the Notre Dame Chapter and has been its secretary since 1942. He has also served as chairman of two national committees—the Constitution and By-Laws Committee and the Publications Committee.

The second new trustee, C. M. Carmichael, was born in Alabama and joined the Anniston Steel Co. in 1915 as assistant works manager. In 1917 he was sent to Canada to start an electric steel plant for the Imperial Munitions Board. On completion of this work he joined Electro Metals, Ltd., until 1924, then organized Electric Steel Foundry, Ltd., and in 1930 went to Shawinigan Chemicals as general manager of the stainless steel and alloys division. He was appointed vice-president and director in 1946. He holds directorships in several other Canadian firms.

Compliments

To Willis R. Whitney and Frank N. Speller, first recipients of two new awards recently established by the National Association of Corrosion Engineers—namely, the Willis Rodney Whitney Award in the Science of Corrosion and the Frank Newman Speller Award in Corrosion Engineering, respectively.

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To A. E. R. Peterka of Lamson & Sessions Co., Cleveland, on the award of the Legion of Merit by the U. S. Army in recognition of his contribution to the high octane gasoline program and distribution of surplus aircraft parts during his wartime term of service with Wright Field and the Reconstruction Finance Corp.

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To International Nickel Co., Inc., on the extension of its Inco fellowship awards to six U. S. universities and to Great Britain, as well as the three existing scholarships awarded in Canada.

To Oscar E. Harder of Battelle Memorial Institute, past president, for his part in developing (in collaboration with Elgin National Watch Co.) the new alloy known as Elgiloy, said to have exceptional strength, toughness and rust resistance.

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To Norman Arnold Nielsen, metallurgical engineer in the engineering research laboratory of the Du Pont Co.'s experimental station at Wilmington, Del., on the award of the 1946 Young Authors' Prize of the Electrochemical Society, for his paper on "Passivation of Stainless Steel".

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To Washington Steel Corp. and its president, T. S. Fitch, on the commencement of commercial operation of its Sendzimir mill for the continuous precision cold rolling of stainless steel sheet and strip in gages from 0.078 to 0.004 in. and widths up to 36 in.

Recent investigations of the variation with temperature of the magnetic susceptibility of annealed and cold worked copper have shown a different temperature dependence for the two treatments. Theoretical basis for the difference.

3-135. Hydrogen Overpotential and the Thermionic Work Function. J. O'M. Bockris. *Nature*, v. 159, April 19, 1947, p. 539-540.

Recent work permits a re-evaluation of the relations between the hydrogen overpotential at various cathodes and the position of the cathode material in the periodic table.

3-136. Thermal Expansion of Co-Fe-Cr Series Alloys and New Alloy "Stainless-Invar". Hakaru Masumoto. *Headquarters Air Material Command Translation F-TS-706-RE*, April 1947, 14 p.

Procedures and results of thermal expansion measurements of ternary Co-Fe-Cr alloys, containing 50% or more of Co. Why stainless invar, Co-Fe-Cr, has a smaller thermal expansion rate than Fe-Co alloys in spite of its anticorrosive and magnetic properties. (From *Nippon Kinzokugakkaishi*, v. 4, no. 4, April 20, 1938, 6 p. Reprint.)

3-137. Magnesium. The Metal of Tomorrow. T. R. B. Watson. *Canadian Metals & Metallurgical Industries*, v. 10, April 1947, p. 13-17, 32.

Properties and applications of the metal and its alloys in lightweight construction.

3-138. A Metallurgical Investigation of Large Forged Disks of Low-Carbon N-155 Alloy. Howard C. Cross and J. W. Freeman. *National Advisory Committee for Aeronautics Technical Note No. 1230*, April 1947, 20 p.

Results of a study of the room-temperature, 1200, 1350, and 1500° F. properties of three large forged disks of low-carbon N-155 alloy. It contains about 20% each of chromium, nickel, and cobalt; and from 0.6 to 3% of each of silicon, columbium, manganese, tungsten, and molybdenum.

3-139. The Failure of Metals by Fatigue. *Metallurgia*, v. 35, April 1947, p. 289-293.

Brief abstracts of some of the papers read at Symposium on the Failure of Metals by Fatigue, held under the auspices of the Faculty of Engineering, University of Melbourne, Australia.

3-140. Flame Hardened Steel. S. T. Jazwinski. *Steel*, v. 120, May 12, 1947, p. 108-109, 146.

In relatively new type of air hardening steel the allotropic transformation is lowered by control of chemical analysis and, as a result, air cooling is sufficient to produce high hardness in depth. Only hardening tool required is an oxy-acetylene torch. Steel is produced in acid openhearth and electric-arc furnace. Steel shows high physical properties and even in high ultimate strength is very ductile. Tables show hardness against drawing temperatures and comparison of hardness between water-quenched and air-quenched surfaces. The tests were made on samples from the same heat.

3-141. The Emissivity of Hot Metals in the Infrared. Derek J. Price. *Proceedings of the Physical Society*, v. 59, Jan. 1, 1947, p. 118-131.

A specially designed vacuum-light, water-jacketed furnace for the measurement of the emissivity of incandescent metals. Results are given for pure platinum, iron, molybdenum, copper and nickel. A split-cylinder type of comparison black-body was used and its efficiency compared with a spherical standard. 26 ref.

3-142. The Temperature Variation of the Emissivity of Metals in the Near Infrared. Derek J. Price. *Proceedings of the Physical Society*, v. 59, Jan. 1, 1947, p. 131-138.

Evidence analyzed for the existence of a wave length peculiar to each metal, for which the temperature coefficient of emissivity is zero. Further experimental data are submitted in support, and it is shown that the appearance of such a phenomenon would explain many of the divergent results obtained for the temperature variation of emissivity in the visible region, besides providing a new series of characteristic wave lengths for metals. 21 ref.

3-143. The Hardened and Tempered Microstructure of High Speed Toolsteel as a Factor in Tool Performance. W. H. Wooding. *Transactions of the American Society of Mechanical Engineers*, v. 69, May 1947, p. 281-306.

Hardened and tempered metallurgical characteristics of a large number of tools representing various types of high speed steels were studied to determine the probable cause for variation in tool life during conduct of continuous roughing-cut performance tests. Studies included the austenitic grain size, hardened and tempered microstructure, the Rockwell hardness of the finished tools, and the Shepherd hardened fracture grain size, as well as comparison of these properties with tool performance.

For additional annotations indexed in other sections, see:

5-29-30; 6-75-81-82-99; 9-57; 18-84-85-92-96; 19-127; 23-130-141-146-151; 24-119-136; 27-93.

4 STRUCTURE — Metallography & Constitution

4-48. Primary Binary Solid Solutions. E. A. Owen. *Journal of the Institute of Metals*, v. 73, March 1947, p. 471-487.

Survey of X-ray measurements of the distortion produced in the crystal lattices of gold, silver, and copper, when the first and second long period elements are dissolved in them.

4-49. Sur l'Anisotropie Optique des Bronzes et des Alliages Cuivre-Antimoine. (Optical Anisotropy of Bronzes and Copper-Antimony Alloys.) Theophile Cambon. *Comptes Rendus*, v. 224, March 17, 1947, p. 837-839.

A crystallographic study of optical anisotropy on bronzes and on CuSb alloys of various phases.

4-50. Internal Friction of Zinc Single Crystals. Irvin H. Swift and John E. Richardson. *Journal of Applied Physics*, v. 18, April 1947, p. 417-425.

Measurements of the internal friction of single crystals of zinc have been previously reported. The present work consists of further observations of the behavior of the decrement of longitudinally oscillating zinc crystals under various circumstances and with partially controlled history.

4-51. Preparation and X-Ray Diffraction Studies of a New Cobalt Carbide. L. J. E. Hofer and W. C. Peebles. *Journal of the American Chemical Society*, v. 69, April 1947, p. 893-899.

The easily hydrogenated carbon produced by the action of CO on finely divided cobalt is shown to be combined with cobalt to form a new crystalline species, Co_2C, whose structure is distinct from either alpha or beta cobalt. X-ray diffraction data indicate that the difficultly hydrogenated carbon is in the form of finely divided carbon crystallites.

4-52. Electrons, Atoms, Metals and Alloys. William Hume-Rothery. *Metals Technology*, v. 14, April 1947, T. P. 2130, 16 p.

British scientist describes some of the advances in the theory of the structure of alloys which have been made in the years between the two world wars.

4-53. Solubility of Carbon in Molten Copper-Manganese and Copper-Nickel Alloys. John R. Anderson and Michael B. Bever. *Metals Technology*, v. 14, April 1947, T. P. 2151, 10 p.

Investigation conducted by saturating liquid samples of copper-manganese and copper-nickel alloys with carbon. The samples were quenched and analyzed for total carbon by a combustion method. Results charted; their practical value. 14 ref.

4-54. The Crystal Structure of AuBe. B. D. Cullity. *Metals Technology*, v. 14, April 1947, T. P. 2152, 5 p.

The structure of the gold-beryllium phase investigated by X-ray diffraction. It was found to be a quite close packed cubic structure, in which the beryllium atoms have forced the gold atoms out of their normal face-centered positions. It is a structure known as the FeSi type.

4-55. The Constitution of the Bismuth-Indium System. Otto H. Henry and Edward L. Badwick. *Metals Technology*, v. 14, April 1947, T. P. 2159, 5 p.

The liquidus and solidus curves of the bismuth-indium phase diagram have been located and two eutectics have been placed. Two intermetallic compounds appear to be BiIn, and $BiIn_2$. A new value for the melting point of indium.

4-56. Experimental Evidence of the Viscous Behavior of Grain Boundaries in Metals. T'ing-Sui Ke. *Physical Review*, v. 71, April 15, 1947, p. 533-546.

A simple torsional apparatus was devised for measuring four types of anelastic effects at very low stress levels. All four types were studied in 99.91% polycrystalline aluminum as well as in single crystal aluminum. The effects observed in polycrystalline aluminum are completely recoverable and are linear with respect to applied stress and prior strain. They satisfy the interrelations derived by Zener from Boltzmann's superposition principle within experimental error, and are consistent with the viewpoint that grain boundaries behave in a viscous manner. Similar anelastic effects were also observed in polycrystalline magnesium, indicating that viscous behavior is common to all metals.

4-57. Grain Growth in High Purity Aluminum. Paul A. Beck, Joseph C. Kremer, and L. Demer. *Physical Review*, v. 71, April 15, 1947, p. 555.

Results of measurement of average grain size in specimens heated for various periods of time (20 sec. to 11 days) and at various temperatures (350 to 650° C.) used to derive certain empirical relationships and theoretical hypotheses.

4-58. The deHaas-van Alphen Effect in a Single Crystal of Zinc. Jules A. Marcus. *Physical Review*, v. 71, April 15, 1947, p. 559.

The diamagnetic susceptibility of a single crystal of zinc was measured from 20 to 373° K. in fields ranging from 4.5 to 10.5 kilogauss. At 20° K. the susceptibility perpendicular to the hexagonal axis is independent of the field while the susceptibility parallel to the hexagonal axis shows a marked field dependence.

4-59. Graphite Formation in Cast Iron and in Nickel-Carbon and Cobalt-Carbon Alloys. H. Morrogh and W. J. Williams. *Journal of the Iron and Steel Institute*, v. 155, March 1947, p. 321-371.

A concise statement of as many as possible of the features of graphite

(Turn to page 22)

Four-Man Panel Discusses Coatings—Plating, Galvanizing, Enamel, Paints

Reported by H. L. Millar

Assistant Metallurgist, Plomb Tool Co.

A discussion of "Surface Protection of Metals" by four local experts featured the second lecture of the Los Angeles Chapter's spring educational program. Chairman of the meeting was Herbert Waterman of the University of Southern California; the discussion group consisted of Orrin E. Andrus, director of the service and development laboratory, A. O. Smith Corp.; C. L. Von Planck, chief metallurgist, Columbia Steel Corp.; D. E. Raife, plant engineer, Norris Stamping and Manufacturing Co.; and Richard B. Pollak, chief chemist, Sillers Paint and Varnish Co.

Speaking on platings and chemical coatings, Mr. Andrus first itemized the major uses of such coatings, namely, for appearance, adherence of organic films, prevention of corrosion, elimination of contamination, physical properties, preservation of dimensions, and nongalling bearing surfaces.

Six major types of metal and metal compound coatings are: heavy metal deposits (usually applied by some form of welding); thermally applied penetration coatings (calorizing, sherardizing, siliconizing, carburizing, cyaniding, and nitriding); sprayed metal deposits; electroplated coatings; electrochemically applied chemical compounds (such as anodized films); and chemically applied metal compounds (oxides, phosphates, sulphides, and chromates). Mr. Andrus closed with a description of some locally made products, their requirements, and the characteristics of the coatings used.

Speaking on galvanizing, tinning and terne coating, C. L. Von Planck said that galvanizing is by far the most economical as well as the most popular. Articles are finished in the wiped or unwiped condition according to thickness and nature of the coating desired. Prime western zinc is generally used and the appearance of the finish is enhanced by spangling, accomplished by small amounts of lead, antimony, cadmium or aluminum in the bath.

Although flash coatings of tin are applied electrically, by far the greatest amount of tinning is done by the hot dip method. Tin cans for food stuffs are coated with 1¼ to 1½ lb. per base box, whereas tin protection on dairy equipment is four to six times heavier. A mixture of lead and tin applied to sheet iron or steel in the manufacture of terne plate gives satisfactory mechanical protection, according to Mr. Von Planck. Porosity, however, harbors ideal conditions for accelerated corrosion.

Vitreous enamel coatings of iron and steel were discussed by Mr. Raife. Equipment used at Norris Stamping Co., Mr. Raife said, is generally conveyerized. The parts to be enameled (bath tubs, sinks, stoves, and cooking utensils) are washed, pickled, rinsed and then given the ground coat of cobalt-nickel silicate mixture which is "burned" before the first white coating is applied to the part. After fusing or "burning" down the second layer, the articles are ready for the final acid resistant titanium oxide coating which is fired at 1560° F. for 3 to 5 min.

Major consideration in the application of organic coatings (paints and lacquers), according to Mr. Pollak, is the thoroughness with which the surface is prepared. Use of rust-inhibiting undercoatings to improve paint quality will increase protective life 800 to 1000%. Mr. Pollak recommended red lead, blue lead, zinc oxide, zinc chromate and phosphating.

The Reviewing Stand

WHEN *Metals Review* started publishing its Review of Current Metal Literature at the beginning of 1944, it was on the strong conviction that the new feature would provide an invaluable service to members of the American Society for Metals, not readily available to them elsewhere. For more than two years the editors and publishers went blithely on their way, bowing to the bouquets, swelling under the shoulder pats, until one day someone unkindly planted an insidious doubt.

"Sure, a lot of your readers like this service," he said, "I like it myself, but how do you know we don't represent just a small proportion of your 22,000 circulation? You're spending a lot of money to review and classify 500 magazine articles and books each month. Better be sure *most* of your readers want it!"

So that's why the questionnaire we mentioned last month got born. How it was conducted to insure we had a scientific sampling, what precautions were taken to prevent any unwarranted interpretation of results, what other important questions were asked and answered, we will save for another telling. But we did find out that the Review of Current Metal Literature was welcomed and valued and used by a weighty majority—89.4% to be exact. And it didn't take long for our doubting Thomas to about-face and admit he was dead wrong!

Many and varied were the comments that accompanied these questionnaires. We weren't particularly surprised when a *research metallurgist* said, "Your Review of Current Literature is fulfilling a great need in this country. It will no doubt grow in value as more men in the field become familiar with this long-wanted tool." But it was a source of considerable gratification to read a *vice-president's* commendation, "The best job of its kind"; this from a *service engineer*, "It is most helpful to me"; and an admonition from a *forging superintendent*, "Keep up the good work. This type of information has proved most helpful in staying abreast of advanced metalworking methods."

Information Wanted

A correspondent writes: "We are in search of some basic information concerning the application of various toolsteels to the manufacture of woodworking knives and form tools. All of the available data seem to be primarily concerned with metalworking, whereas we would like to get on the track of some literature wholly along woodworking lines." Can anyone help him?

Another reader wants to get some parts made from sintered steel. He has found a source of the material, but this company is unable to fabricate the parts he wants.

A third is looking for a source of alloy wire for wire recording 0.004 in. or less in diameter, and a source of supply for metal-coated paper used as a "metallic ribbon". We have given these readers several suggestions, but would be glad to forward communications containing more specific advice.

M. R. H.

formation in cast irons which need explanation, together with a critical examination of numerous theories. The metallography of graphite in relation to its crystal structure and the solidification of flake graphite-containing iron. Process of graphite formation in nickel-carbon, nickel-iron-carbon, and cobalt-carbon alloys, and the analogies between the mechanism of the process in these alloys with that in cast irons. Undercooling of cast irons and of similar alloys. 115 ref.

For additional annotations indexed in other sections, see:
3-117; **6**-75-78-91; **7**-186; **11**-48-58; **14**-129-139; **18**-84-91; **19**-144; **24**-130; **27**-93.

5 POWDER METALLURGY

5-26. Electrolytic Method of Preparation of Powdered Nickel. A. I. Levin. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 779-792. (In Russian.)

Cathodic precipitation of nickel in powdered form followed by annealing of the product in hydrogen at approximately 700° C. is the best method for production of high-activity powdered nickel.

5-27. Cathodic Preparation of a Finely Dispersed Nickel. M. Loshkarev, O. Gornostaleva, and A. Kriukova. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 793-800. (In Russian.)

Optimum conditions for preparation of powdered nickel from pure $NiSO_4$ solution and from electrolytes containing copper ions. The products possess high activity in both cases.

5-28. Production of Cemented Tungsten Carbide. Stuart H. Brierley. *Metallurgia*, v. 35, March 1947, p. 253-254.

The double-sinter and the single-sinter methods and the advantages of each.

5-29. Iron-Graphite Powder Compacts. Alexander Squire. *Metals Technology*, v. 14, April 1947, T. P. 2164, 10 p.

Effects of material and processing variations upon the tensile properties of steel formed from mixtures of iron and carbon. The study was made to provide information regarding the properties obtainable in iron-carbon compacts as influenced by forming pressure, sintering temperature, and graphite particle size.

5-30. Density Relationships of Iron-Powder Compacts. Alexander Squire. *Metals Technology*, v. 14, April 1947, T. P. 2165, 19 p.

Difficulty experienced in the determination of the mechanical properties of compacted components has made design engineers hesitant to use powder-metal parts. The work described is an attempt to remedy the situation. Effects of variations in density of compacts from several types of iron powder on mechanical properties. Effects of die configuration and frictional forces, of sintering temperature, and of shape of compact, on density.

5-31. Powder Metallurgy. J. W. Lennox. *Machinery (London)*, v. 70, April 3, 1947, p. 337-344.

Manufacture and control of powder; pressing the compact; sintering; coining for accurate size control; limitations of the pressing operation; examples of parts produced; physical properties.

5-32. Advantages of Self-Lubricating Bearings Made by Powder Metallurgy. M. T. Victor. *Canadian Metals & Metallurgical Industries*, v. 10, April 1947, p. 18-21, 38.

Established and tested procedures and processes wherein powder metallurgy has proven its advantages over orthodox methods in the production of bearings and bushings.

5-33. Production of Cemented Tungsten Carbides. E. J. Sandford and E. Ineson. *Metallurgia*, v. 35, April 1947, p. 298-300.

Correspondents from two firms engaged in the manufacture of tungsten carbides criticize Brierley's paper in March issue.

For additional annotations indexed in other sections, see:
2-77-79.

6 CORROSION

6-75. Nouvelles Recherches sur l'Oxydation du Fer aux Temperatures Elevées par la Méthode Micrographique. (New Research on the High-Temperature Oxidation of Iron by Micrographic Methods.) J. Benard and O. Coquelle. *Revue de Métallurgie*, v. 43, March-April 1946, p. 113-124.

Thorough X-ray investigation of a large number of test specimens permitted establishment of the dependence of iron oxide growth and structure on the temperature and nature of the alloying elements. 10 ref.

6-76. Recherches sur la Corrosion en Angleterre et aux Etats-Unis Pendant la Guerre (1940-1945). (Research on Corrosion in England and U.S.A. During the War—1940-1945.) E. Herzog. *Métaux et Corrosion*, v. 21, July 1946, p. 92-100.

A review.

6-77. Use of Corrosion Inhibitors in Products Pipe Lines. Ivy M. Parker. *Proceedings American Petroleum Institute*, v. 26, section V, 1946, p. 26-36.

Results of a survey of 19 companies. 12 ref.

6-78. The Mechanism of the Sulphide Corrosion of Iron. P. V. Geld and O. A. Esin. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 7, 1946, p. 678-683. (In Russian.)

Comparison between experimental data for sulphide and for oxide corrosion of iron revealed certain similarities. The main difference seems to be that the concentration of components in the lattice structure of the iron-sulphur system varies over a larger range than in the iron-oxygen system.

6-79. Regularities in the Action of Organic Acids. V. D. Iakhontov. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 8, 1946, p. 761-772. (In Russian.)

An investigation of the actions of a number of organic acids on steel, lead, tin, copper, and aluminum resulted in the observation of certain regularities in their behavior, especially in connection with dissociation constants and concentrations of acids, temperatures, and times of action.

6-80. Corrosion and Oxidation Experiences in High-Pressure and High-Temperature Steam Service. Paul M. Brister and J. B. Romer. *Electrochemical Society Preprint 91-17*, 1947, 23 p.

Corrosion experienced with metals used for steam-generating tubes and superheater tubes for high-pressure boilers. Methods of relief and interpretation of the causes of corrosion of steam-generating tubes. For high temperature superheater tubes, it is shown how temperature shock affects the rate of corrosion on the steam side and the gas side of the tube.

6-81. High-Temperature Corrosion of Metals Under Alternate Carburization and Oxidation. Harry K. Ihrig. *Electrochemical Society Preprint 91-23*, 1947, 11 p.

Laboratory and extensive pilot and large commercial plant tests. From the evidence presented, it is believed that the high chromium steels, such as 26% Cr, are the best for this service. The protective action of small amounts of sulphur in the feed stock.

6-82. The Oxidation of Metals. W. E. Campbell and U. B. Thomas. *Electrochemical Society Preprint 91-24*, 1947, 16 p.

A simple method for measuring low oxidation rates at elevated temperatures. Oxidation rate of copper is measured in pure oxygen at five temperatures from 100 to 256° C. Annealed copper oxidizes more rapidly than unannealed copper at 169° C., an effect which is believed to be due to an increase in specific surface due to recrystallization in annealing. The oxidation-rate curves for a large number of copper alloys, nickel, and stainless steel are presented at 194, 256, and 302° C.

6-83. Resistance a la Corrosion des Assemblages d'Aluminum Soudés par Points. (Corrosion Resistance of Spot Welded Aluminum Assemblies.) Nicolas Beliaeff. *Revue de l'Aluminium*, v. 24, Jan. 1947, p. 3-9.

A series of corrosion tests (alternate immersion in salty atmospheres at room temperature and at 40° C. and long-time tests in sea water) on spot welded aluminum alloys having a protective coating of paint, oxide, or pure aluminum plating.

6-84. L'Emploi de la Laine de Verre pour L'Isolement Thermique d'Appareils en Alliages Légers. (The Use of Glass Wool as Thermal Insulation in Light-Alloy Apparatus.) Jean Herenguel. *Revue de l'Aluminium*, v. 24, Jan. 1947, p. 10-11.

In investigation of corrosion of a double-walled electric boiler made of an aluminum-magnesium alloy having glass-wool insulation between the walls it was found that alkalinity of the insulating material and the presence of water should be avoided in order to eliminate corrosion at temperatures above 100° C.

6-85. Der Chemische und Anstrichtechnische Korrosionsschutz des Magnesiums. (Surface Corrosion Protection of Magnesium by Means of Chemical Reactions and by Coating With Protective Materials.) Hellmuth Weis. *Mitteilungen des Chemischen Forschungsinstitutes der Industrie Osterreichs*, v. 1, Feb. 1947, p. 42-44.

Comparison of the resistance to corrosion of a magnesium surface after chemical or electrolytic treatment with that of one coated with protective substances such as paints, varnishes, resins.

6-86. The Corrosion of Iron and Steel and Its Prevention. J. C. Hudson. *Journal of the Oil & Colour Chemists' Association*, v. 30, Feb. 1947, p. 35-49; discussion, p. 49-52.

Based largely on the experimental findings of the Corrosion Committee of the Iron and Steel Institute and the British Iron and Steel Research Association. Particular attention paid to atmospheric corrosion.

6-87. Measurement of Corrosion Pits in Boiler Tubes. B. M. Thornton. *Engineering*, v. 163, March 28, 1947, p. 229-230.

A tool designed to detect and measure corrosion pits using an electrical instrument previously described for measuring the thickness of boiler tubes in place, and of nonferrous castings. A new exploring head was designed by means of which the location and presence of serious pitting is detected. One man moves the head steadily through the tube, while another watches the micro-ammeter.

(Turn to page 24)

New Akron Chapter Has First Meeting




Columbus Floyd — *A. C. Gunsaulus* — *J. L. Oberg* — *R. A. Osborn*

Reported by J. L. Oberg
Metallurgist, Babcock & Wilcox Co.

The first regular meeting of the new Akron Chapter of the American Society for Metals was opened on May 7 by A. J. B. Fairburn, head of the department of metallurgical engineering of Akron University. Professor Fairburn was chairman of the organization committee responsible for the formation of the Chapter.

Most important business of the evening was the election of permanent officers, as follows:

CHAIRMAN—Columbus Floyd, metallurgical engineer, Babcock & Wilcox Co.

VICE-CHAIRMAN—A. C. Gunsaulus, manager of development, wheel and brake division, Goodyear Aircraft Corp.

SECRETARY—James L. Oberg, metallurgist, Babcock & Wilcox Co.

TREASURER—Robert A. Osborn, district manager, Peninsular Steel Co.

EXECUTIVE COMMITTEE—James Allison, chief metallurgist, Star Drilling Machine Co.; Clifford R. Augden, metallurgist, B. F. Goodrich Co.; A. J. B. Fairburn, department of metallurgical engineering, University of Akron; John A. Hansen, factory manager, Firestone Steel Products Co.; Lawrence W. Hudson, chief metallurgist, Goodyear Aircraft Corp.; John L. Miller, chief metallurgist, Firestone Tire & Rubber Co.

During the evening, Ray T. Bayless, assistant national secretary of the A.S.M., traced the history of the society from its beginning, and concluded with his version of the brief history of this newest chapter. Following the election, Denton T. Doll, treasurer of the Cleveland Chapter, passed on to the members some of the wisdom of his many years' experience in A.S.M. organization, and renewed the offer of the Cleveland Chapter to help. While the officers will carry the burden of the year's work, it also requires the combined efforts of the entire membership, he said.

Two short movies on minerals and ore movement, presented by J. Allison, closed the activities of the evening.

Campus Open House at M.S.M.

Reported by Louis Malpoker
Lincoln Engineering Co.

The annual joint meeting of the St. Louis and Missouri School of Mines Chapters was held on April 26 at Rolla. The meeting opened with technical talks at Parker Hall and an open house in metallurgy at 3:30 p.m. A. W. Schlechten of the Missouri School of Mines faculty lectured on zirconium.

Principal speaker of the evening was W. M. Owen, assistant director of training, Caterpillar Tractor Co., who spoke on "What the Graduating Engineer Can Expect in Industry".

6-88. The Corrosion of Metals. Part VII. (Continued.) *Sheet Metal Industries*, v. 24, April 1947, p. 801-806.
The corrosion of zinc sheet and of the die-casting alloys.

6-89. The Use of Alloys for Imparting Corrosion Resistance to Iron and Steel. E. A. Tice. *Steel Processing*, v. 33, April 1947, p. 211-215.
Effects of copper, phosphorus, silicon, nickel, chromium, molybdenum, columbium and titanium; proprietary low-alloy, high-strength steels; seawater, natural water, and soil corrosion.

6-90. Novel Ground Bed for Cathodic Protection. Tom R. Statham. *Petroleum Engineer*, v. 18, April 1947, p. 53-54.
Installation for protection of three 8-in. and one 10-in. pipe line in an extremely corrosive area near Corsicana, Texas. Two drill cables doped with insulating material were placed in a ditch parallel to and 250 ft. away from the pipe lines. 20-ft. pipe lengths were welded to the drill cables at intervals determined by soil-resistance measurements. Seventeen 8-volt, 20-amp. rectifiers were installed on the 4-mile stretch. In four years of operation, no corrosion leaks have occurred.

6-91. Electron Diffraction Study of Oxide Films Formed on Molybdenum, Tungsten, and Alloys of Molybdenum, Tungsten and Nickel. J. W. Hickman and E. A. Gulbransen. *Metals Technology*, v. 14, April 1947, T. P. 2144, 17 p.
Survey of the literature. Study of existence diagrams of the oxides occurring on molybdenum and tungsten; existence diagrams of the oxides occurring on the alloys 80% Mo, 20% W; 93% Mo, 7% Ni; 93% W, 7% Ni; and effects of heating and cooling the oxides that form on these metals and alloys. 22 ref.

6-92. Weathering Effects on Magnesium Coatings. Loring R. Williams and George W. Sears. *Light Metal Age*, v. 5, April 1947, p. 10-11, 22.
Studies were carried out in western Nevada because of its altitude, extent of sunshine, and wide daily temperature range. Sheet magnesium and surface coatings were of commercial grade. Approximate composition was 3.5% aluminum, 0.1% manganese, 1.3% zinc, and 95.1% magnesium. Preparation of test plates; weathering tests; observations made during the weathering period and observations made at the end of test.

6-93. Hydrogen Peroxide. Structural Materials, Manufacture and Uses. J. S. Reichert and R. H. Pete. *Chemical Engineering*, v. 54, April 1947, p. 213-214, 216, 218, 220, 222, 224, 226, 228.
The fitness of various materials from the standpoint of corrosion resistance and activity as catalyzers of peroxide decomposition. Stabilizers suggested for certain cases. Manufacturing methods and applications.

6-94. Facts and Factors of Boiler Corrosion. K. R. Hodges. *Industry and Power*, v. 52, May 1947, p. 88-89.
Effects of overheating as well as chemical, electrochemical, and galvanic action that cause common corrosion difficulties.

6-95. Is Corrosion Taking $ $ From Your Pocket? Bradford J. Cotey. *Oil and Gas Journal*, v. 46, May 10, 1947, p. 68, 71, 92-93.
Beneficial results of using the chemical inhibitor made by Turco Products, Inc., to prevent oil-well corrosion.

6-96. Mechanism of Protective Action of Alloying Elements During the Sulphide Corrosion of Iron. P. V. Geld and O. A. Essin. *Journal of Applied Chemistry (U.S.S.R.)*, v. 19, no. 9, 1946, p. 861-868. (In Russian.)
A new interpretation of the mechanism of the protective action of alloying elements vs. sulphur corrosion by which the protective action of chromium and aluminum and the absence of such action in the case of nickel and manganese may be explained. 17 ref.

6-97. Azione Inibitrice del Cromato Sodico e del Permanganato Potassico Nell'Attacco dell'Alluminio in Soluzioni Dilute di Idrato Sodico, a Diverse Temperatures. (Inhibiting Action of Sodium Chromate and Potassium Permanganate on Attack on Aluminum by a Dilute Solution of Sodium Hydroxide, at Various Temperatures.) Nello Collari. *Alluminio*, v. 15, Jan-Feb. 1947, p. 13-21.
Sodium chromate and potassium permanganate inhibit attack on 99.5 aluminum immersed in a 0.5 to 1% solution of NaOH at 20 to 50° C., by forming protective oxide layers on the aluminum. While the degree of effectiveness varies with the temperature, in general, potassium permanganate is the more effective agent.

6-98. Vertical Turbine Pumps. T. E. Larson. *Water & Sewage Works*, v. 94, April 1947, p. 117-121.
Pump corrosion as caused by galvanic action, carbon dioxide, and stray currents; prevention methods.

6-99. Das Korrosionsverhalten des Aluminiums als Werkstoff in der Chemischen Industrie. (Corrosion Resistance of Aluminum as a Material in the Chemical Industry.) E. Zurbrugg. *Chimia*, v. 1, April 1947, p. 74-76.
The properties of aluminum which make it suitable as a material for chemical apparatus. The effect of impurities and alloying elements in increasing or decreasing corrosion resistance.

6-100. Sheet Pile Corrosion at Port of Copenhagen. Mogens Blach and Axel Rogberg. *Engineer*, v. 183, April 25, 1947, p. 348-350.
Results from an extensive study of corrosion of steel-sheet piles. Measurements were made both of the reduced thicknesses of actual piles, and of the reduced weights of test specimens immersed for periods as long as 21 years. Economics of using thicker sheet.

6-101. Corrosion on Gasworks. A. J. Brandram. *Arrow Press Technical Publications*, no 10, 1947, p. 2-13; discussion, p. 13-15. (Supplement to *Gas Times*, v. 51, April 26, 1947.)
An extensive discussion of the atmospheric corrosion of the various iron and steel structures in manufactured-gas establishments. Includes both the theoretical and the practical side, giving results of experimental work on corrosion of various metals, as obtained from the literature. Methods of prevention of corrosion.

6-102. Cathodic Protection. H. H. Anderson. *Railway Signaling*, v. 40, May 1947, p. 306-308.
A simplified explanation of the corrosion of metals in the soil, and of cathodic protection.

6-103. Atmospheric Corrosion of Iron and Steel. Frederick C. Strong. *Monthly Review*, v. 34, May 1947, p. 551-556.
Definitions of corrosion terms. The mechanism of corrosion by moist air and by atmospheric impurities. Protection of iron and steel. 12 ref.

6-104. Materials in Boiler Feed-Pump Construction. H. L. Ross. *Combustion*, v. 18, April 1947, p. 43-44.
Influence of various factors on corrosion-erosion when employing carbon steel.

6-105. Corrosion-Erosion of Boiler Feed Pumps and Regulating Valves. H. A. Wagner, J. M. Decker and J. C. Marsh. *Transactions of the American Society of Mechanical Engineers*, v. 69, May 1947, p. 389-397; discussion, p. 397-403.
Seven 500-hr. corrosion-erosion tests, involving 18 different materials, were conducted at the Marysville power plant of the Detroit Edison Co. to determine resistance to attack in boiler feed pumps and regulating valves. Five tests indicated that resistance to corrosion-erosion is materially increased by using chromium-bearing alloy steels. Bronzes and monel are resistant and, to a lesser extent, cast iron. Results obtained with a bakelite lacquer-coated carbon steel indicated considerable promise for boiler feed pumps having cast steel casings.

6-106. Investigation of Acid Attack on Boilers and the Effect of Repeated Acid Cleaning on the Metal. H. C. Farmer. *Transactions of the American Society of Mechanical Engineers*, v. 69, May 1947, p. 405-411; discussion, p. 411-412.
Investigation shows that stressed metal is more readily attacked by inhibited acid than stress-relieved metal. With a knowledge of the controlling factors, such as temperature, acid strength, and contact time, the operator can acid-clean boilers with a reasonable assurance that corrosion or metal attack will be reduced to a minimum.

For additional annotations indexed in other sections, see:

3-130-137; **8**-75; **23**-146; **24**-131; **27**-92.

7 CLEANING & FINISHING

7-160. Phosphate Treatments. W. F. Coxon. *Metallurgia*, v. 35, March 1947, p. 233-234.
Letter criticizes several points made by E. E. Halls in his paper in December issue. Mr. Halls' reply.

7-161. Chromate Finishes to Protect Zinc Surfaces. George Black. *Materials & Methods*, v. 25, April 1947, p. 113-116.
Three major lines of zinc after-treatments: Cronak, Iridate, and coatings known as Unichrome Dip.

7-162. Coloring of Aluminum and Its Alloys. *Materials & Methods*, v. 25, April 1947, p. 145.
Tabulation of the various colored effects which may be produced.

7-163. Metal Cleaning With the Sodium Hydride Process. H. L. Alexander. *Materials & Methods*, v. 25, April 1947, p. 156-157.
Process utilizes the reducing action of small quantities of sodium hydride, dissolved in a fused-caustic carrier bath operated at 700° F. A water quench and rinse follow. Applications.

7-164. Resurfacing Freeze Rolls by Metal Spraying Method. *Rubber Age*, v. 61, April 1947, p. 68.
Technique used in repair of a rubber-processing roll.

7-165. A New Anti-Cementation Coating. L. M. Kamionsky. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 157.
A protective mixture which deposits a layer of copper on metal parts for which electroplating is not convenient or practicable. (Condensed from *Vestnik Mashinostroenia*, no. 2 and 3, 1946, p. 71-72.)

7-166. Painting and Infrared Baking of Electrical Switch Enclosures. W. H. Yeamans. *Organic Finishing*, v. 8, April 1947, p. 9, 11-13, 15-16.
A complete washing, rinsing, drying, dipping, and baking setup, installed for the purpose of simplifying painting operations, as well as increasing the flow of finished boxes to the new assembly lines.

7-167. The Kolene Process. Carl H. Lekberg. *Industrial Gas*, v. 25, April 1947, p. 11, 27-29.
Salt-bath techniques developed by Kolene Corp. for cleaning metals before coating with various materials.

7-168. Some Fundamental Aspects of the Hot Dip Galvanizing Process. W. L. Hall and L. Kenworthy. *Sheet Metal Industries*, v. 24, April 1947, p. 741-752, 758.
Hitherto unpublished work concern-

(Turn to page 26)

Use and Selection of Ferro-Alloys Based On Three Criteria

Reported by Roy E. Woodbury

Metallurgist, Republic Steel Corp.

A rather far-fetched and very amusing coffee talk opened the meeting of the Mahoning Valley Chapter ● on March 10. It was delivered by one Sir Cyril Cosgrove-Clippingham, who was very well impersonated by Stanley O'Dea of Carnegie-Illinois Steel Corp.; Sir C.C.C. convinced himself that he had revolutionized the steelmaking industry by the introduction of ozone to the openhearth bath.

Karl L. Fetters then introduced Robert K. Kulp, metallurgist, Electro Metallurgical Co., who presented a talk on "Metallurgy of Finishing Additions in Basic Openhearth Steelmaking". Approximately 100 members and guests were in attendance, including practically all openhearth supervisors in the valley.

The presence of iron in many ferro-alloys is purely incidental, Mr. Kulp said, and the use of richer ferro-alloys results in less chilling action on the metal. He cited three basic reasons for the use of ferro-alloys, namely, *(a)* to control solidification in the molds, *(b)* to expedite steel processing, such as hot rolling, carburizing, and machining, and *(c)* to confer upon the finished steel certain desired physical properties.

As a criterion for the selection of ferro-alloys Mr. Kulp advised: "Specify those alloys which will accomplish the intended job satisfactorily in the most economical manner." This criterion applies to both deoxidizers and alloying elements.

Mr. Kulp reviewed Tennenbaum's work on deoxidation, which indicates that, for a medium carbon steel, the oxygen content is a function of temperature rather than deoxidizing element (that is, drop in temperature is more effective in lowering oxygen than is the addition of deoxidizers). Oxygen content of steel in the ingot mold is independent of carbon content. The effect of spiegel reboil is to lower the oxygen content in the metal and raise the temperature. Cleanliness of the finished steel appears primarily dependent upon the oxygen content of the metal at the time of initial deoxidation.

The thermal effect of various grades of ferrosilicon which can be used for deoxidation was illustrated by slides. It was shown that the use of ferrosilicon containing 75% or more of silicon does not lower the metal temperature. In choice of ferro-alloys solution rate should be considered more pertinent than the melting points of the specific alloys. Mr. Kulp closed with the reminder that ferro-alloys cost money, and that good housekeeping in the mills is imperative.

In the discussion period that followed, Mr. Kulp voiced the belief that the use of oxygen in the openhearth may revolutionize steelmaking processes. By using oxygen, steelmaking capacity may be expanded with less capital investment than would be required to build new furnaces. In order to gain greatest efficiency from the use of oxygen, openhearth furnaces may have to be radically redesigned.

Celebrities at Openhearth Night

Left to Right at Mahoning Valley's Openhearth Night Are Karl L. Fetters, Technical Chairman; Robert K. Kulp, Speaker; Myron A. Hughes, Chapter Chairman; and Sir Cyril Cosgrove-Clippingham, Alias Stanley O'Dea

Grossmann Describes Improvements in Steel

Reported by F. J. Borgstedt

Consulting Metallurgist

Covering "New Developments in Steel" ranging all the way from the blast furnace to the completed, process annealed steel ready to leave the plant, M. A. Grossmann, director of research, Carnegie-Illinois Steel Corp., addressed the March meeting of the Des Moines Chapter ●.

Dr. Grossmann told of improved control of furnaces, including blast, bessemer, openhearth and electric. Effects of various new alloying additions and developments in heat treating—induction heating, austempering and martempering—were included in the talk. Slides depicting charts of metal characteristics and response to heat treatment were shown, along with pictures of equipment for electrolytic tin plating.

ing methods of controlling the properties of galvanized coatings. Results of series of investigations conducted by British Non-Ferrous Metals Research over a number of years.

7-169. From Airplanes to Kitchen Ranges and Frozen Food Cabinets. Gerald Eldridge Stedman. *Finish,* v. 4, May 1947, p. 13-16, 50.

Porcelain-enameling operations at the new Consolidated Vultee plant in Nashville.

7-170. The Properties of Porcelain Enamel and Their Effect Upon Enamelware. Part III. H. D. Carter, B. W. King, and H. C. Draker. *Finish,* v. 4, May 1947, p. 17-18, 52.

Investigation shows that a close relationship exists between enamel properties and values obtained on the finished enameled ware when tested according to E.U.M.C. standards. Cover coat compositions have been confined to those containing antimony.

7-171. Anodizing of Magnesium Alloys for Protection and Appearance. George Black. *Product Engineering,* v. 18, May 1947, p. 122-124.

Electrolytic process forms protective and decorative magnesium-oxide-silicate film on alloys of magnesium. Selection of a.c. or d.c. process and the effect of film on corrosion, mechanical properties, dielectric strength, and alkalinity.

7-172. Metal Spray Reconditions Plug Valves for Longer Life. B. L. Bailie. *Power,* v. 91, May 1947, p. 80-81.

Repair process; spraying operation; machining operation; surface grinding.

7-173. Modern Tumbling Techniques Cut Finishing Costs. Herbert Chase. *Iron Age,* v. 159, May 1, 1947, p. 62-66.

The latest methods used in wet and dry tumbling for buffing, deburring, polishing and honing metal parts, and examples of savings effected at the Shakespeare Co. plant in the finishing of a variety of parts.

7-174. Metal Cleaning—Methods and Results. Jas. Rowan Ewing. *Steel,* v. 120, May 5, 1947, p. 100-101, 140, 142, 144.

Mild alkalis, liquid hydrocarbons, chlorinated solvent vapors, emulsions of hydrocarbon grease solvents and water and multiple-phase-type cleaners.

7-175. Quick Guide to Solutions for Stripping Metal Overlays. J. B. Mohler. *Iron Age,* v. 159, May 8, 1947, p. 66-67.

A quick guide to the selection of the solution most suitable for stripping a given plate from a specific base metal. Solutions are arranged in order of preference. Tables present recommended methods and makeup of solutions.

7-176. The Phosphate Treatment of Metals Prior to Painting. H. A. Holden. *Journal of the Oil & Colour Chemists' Association,* v. 30, March 1947, p. 61-70; discussion, p. 71-72.

The principles, procedures, types of process, and advantages of phosphate treatment. Work of the U.S. Bureau of Standards and of the British Standards Institution.

7-177. Vitreous Enameling of Chemical Plant. James D. Currie. *Foundry Trade Journal,* v. 81, April 17, 1947, p. 305-311; April 24, 1947, p. 329-333; discussion, p. 333.

Materials which are mainly used by chemical manufacturers for the construction of their plants; many and varied uses to which they can be put. Enameling techniques and the testing of enameled surfaces.

7-178. Metallizing Takes Over. Edwin Laird Cady. *Scientific American,* v. 176, May 1947, p. 201-203.

Various applications.

7-179. Spraying in Electrostatic Zones. John Parina, Jr. *Steel,* v. 120, May 12, 1947, p. 106-107, 139-140, 144.

How guided spraying is cutting material costs and improving quality while doubling and tripling production in finishing departments of diverse industries.

7-180. Aluminum Finishes. Frank Taylor. *Metallurgia,* v. 35, April 1947, p. 297.

Discussion of paper, "Aluminum Developments," by S. A. J. Sage in the February issue.

7-181. Surface Hardening of Aluminum and Its Alloys. Frank Taylor. *Metallurgia,* v. 35, April 1947, p. 298.

Discussion of paper of same title by Robinson and Mott in February issue.

7-182. Surface Preparation and Film Thickness. Henry L. Bottemiller. *Paint, Oil & Chemical Review,* v. 110, May 15, 1947, p. 14-15, 36-37, 40.

Results of a Navy paint-testing program in which application techniques, as well as different paints, were evaluated. Results indicate that the poor service given by most ship paint jobs during the war was caused by improper application techniques and lack of a sufficient number of coats. Four coats are superior to two.

7-183. Plastic Coating Expedites Stainless Stamping Operations. W. A. Phair. *Iron Age,* v. 159, May 15, 1947, p. 47-51.

Use of strippable plastic coating on stainless steel sheets gives promise of permitting substantial reductions in finishing costs in stamping, particularly deep-drawing operations, by eliminating die marks and other marring of the surface. Reports from several stamping plants using this material.

7-184. Degreasing and Rust-Inhibiting With Infrared. *Iron Age,* v. 159, May 15, 1947, p. 51.

Employment of an infrared burn-off oven designed for treating sheet-metal products prior to painting. Process burns off grease and similar film and simultaneously produces a blue surface described as a tight scale which protects hidden surfaces not ordinarily reached by rust resistant liquids.

7-185. Infrared Finishing Ovens. Ira J. Barber. *American Paint Journal,* v. 31, May 19, 1947, p. 58, 60, 63-64, 66-67.

The economics of paint baking.

7-186. Electropolishing—What Is Its Status Today? Charles L. Faust. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 49-73; discussion, p. 73-74.

History of its development including a table which shows the patent coverage of the various processes. The limitations and advantages of the process. Recommended solutions and procedures for electropolishing stainless steel, carbon and alloy steels, nickel, copper, brass, monel and nickel silver, aluminum, and cadmium. Possible application to other metals, costs, and metallographic applications.

7-187. Examination of Electrocleaned Steel by Electron Diffraction Technique. C. W. Smith and I. L. Karle. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 117-127; discussion, p. 127-128.

Electron micrographs illustrate the results of an investigation of the chemical composition of steel surfaces cleaned under controlled conditions. A particular point of interest was to determine whether compounds of iron were formed by combination with common cleaning materials such as caustic soda, sodium metasilicate, and trisodium phosphate. If compounds were found to be present, it was also determined whether they were removed by an acid dip prior to the plating cycle.

7-188. The Effect of Surface Preparation on the Durability of Organic Coatings. V. M. Darsey. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 130-140; discussion, p. 140-141.

Methods of metal preparation prior to painting and methods for determining surface cleanness. The effects of different methods of surface preparation on corrosion of steel and on paint retention determined by outdoor-exposure tests. Superiority of phosphate coating techniques. 15 ref.

7-189. Coating, Strippable, Spray Type. E. H. Bucy. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 141-144; discussion, p. 144.

Spray-packaging type of coating developed for the Navy for storage of military equipment. Application methods.

7-190. Resins of the Vinyl Family in Metal Finishing. F. L. Scott. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Session),* 1946, p. 152-162; discussion, p. 171-172.

Properties of polyvinyl esters, and vinyl and vinylidene chloride polymers and copolymers. General requirements of resins used in contact with plating solutions, and in maintenance of coatings and product finishes.

7-191. Stripping of Copper From Various Base Metals. F. C. Mathers. *Proceedings of the American Electroplaters' Society, (33rd Annual Technical Sessions),* 1946, p. 177-181.

Advantages and limitations of the various present and proposed methods.

7-192. Manodyzing and Dye Coloring Magnesium Alloys. Paul R. Cutter. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 257-284; discussion, p. 284-285.

A new electrolytic method which forms a protective and decorative magnesium oxide and silicate film on the surface of magnesium alloys. The application of the coatings, preparation and control of solutions, use of organic finishes over the Manodyz coating, and application of dye coloring.

7-193. Practical Facts About Polishing and Buffing Compounds. Howard J. McAleer. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 285-292.

Different types of buffing compounds and their applications.

7-194. Parkerizing: Growth or Shrinkage? N. A. Tope. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions),* 1946, p. 293-304.

Experiences in the application of phosphate coatings to ⅜ in. high-tensile steel studs on a production basis. Difficulties were experienced in maintaining the extremely close thread dimensional limits required. When the operation was first set up, there was little either of decrease or increase in dimensions, but later there were many cases of growth by as much as 0.004 in. in effective diameter, and of an excessively crystalline deposit. Investigation of various factors resulted in elimination of most of the difficulty.

For additional annotations indexed in other sections, see:
6-83-85-103-105; **8**-63-75; **9**-55; **10**-78; **11**-51; **18**-94-95; **19**-145; **22**-247; **23**-145-147; **27**-100.

8 ELECTROPLATING

8-59. Contribution a l'Etude du Zingage Electrolytique Brillant en Solution Cyanurée Additionnée de Sulfure de Sodium. (Electrolytic Bright Zinc Plating Using a Cyanide Bath With Added Sodium Sulphide.) Marcel Ballay and Pierre Vogt. *Métaux et Corrosion,* v. 21, July 1946, p. 89-91.

A cyanide bath for zinc plating does

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New Haven Chapter Gets Early Replica Of Howe Medal

Presentation of a bronze replica of the Henry Marion Howe Medal of the A.S.M. by Harry C. Goodwill to the New Haven Chapter was an unusually interesting event on the program for National Officers Night, April 17. The medal was established in 1923 by the society to honor Henry Marion Howe, long-time professor of metallurgy at Columbia University and known as an originator of the science of metallography. It is awarded annually to the author of the paper of highest merit published in the ⊕ *Transactions*.

History of the medal is closely linked to the New Haven Chapter, since it was designed by Henrik Hillbom of R. Wallace & Sons Mfg. Co. of Wallingford, and the dies were made by the Keller Mechanical Engineering Corp., now a branch of Pratt & Whitney Division of West Hartford.

At the time the first medal was struck, a bronze duplicate was made at the instigation of Harry C. Goodwill, then superintendent of the die and tool department of R. Wallace & Sons. This duplicate has been in his possession since, until he presented it to the New Haven Chapter in April. At the same time he also presented to the chapter an autographed copy of the proceedings that accompanied the presentation of the John Fritz Medal to Dr. Howe. This had been given to Mr. Goodwill many years ago by Mrs. Howe.

National ⊕ President A. L. Boegehold presented his talk on hardenability as the technical feature of the evening, and certificates commemorating 25 years of continuous membership in the society were presented to several members of the chapter.

Two Welding Talks Given

Reported by R. M. Spencer

Test Engineer
National Forge & Ordnance Co.

The Northwestern Pennsylvania Chapters of A.S.M. and the American Welding Society held a joint meeting on April 24. In a short after-dinner speech, S. V. Williams of Struthers Wells Corp. discussed the importance of fusion welding, past and future.

Speaker of the evening was A. R. Lytle of the research laboratory of Union Carbide and Carbon Co. His interesting and timely talk on pressure welding was well illustrated by slides and was followed by a color movie.

Collison to Sales Manage Hilton Hotel Chain

ASM'ers will be delighted to learn of the important promotion which has just been given to one of their best friends, R. L. "Dick" Collison, director of sales of the Palmer House, who has been placed in charge of sales of the world's largest hotel group, the Hilton Hotels. The Hilton group, besides the Palmer House and the Stevens in Chicago, has hostelries from New York to Los Angeles and as far south as the Biltmore in Palm Beach and the Palacio Hilton in Chihuahua, Mexico.

R. L. Collison

For many years, while Dick was climbing the ladder to the topmost round, he served the society by handling its requirements for convention meeting rooms and seeing to the comforts of A.S.M. members. Collison's permanent headquarters will continue to be in the Palmer House at Chicago, which will be the headquarters for the American Society for Metals during the 29th National Metal Congress and Exposition, Oct. 18 to 24, 1947.

Lindeblad, Kloster President, Dies

Einar Lindeblad, president of Kloster Steel Corp., died in Chicago on May 3. He had been active in the toolsteel business in the middle west for the past 30 years, and was a longtime member of the American Society for Metals.

not produce a highly reflective surface. The same bath with addition of 2 g. per liter of crystallized sodium sulphide results in a bright coating. It is believed that the formation of colloidal zinc sulphide is responsible.

8-60. Electrodeposited Silver on Steel for Glass-to-Metal Seals. Norman S. Freedman. *Electrochemical Society Preprint 91-19*, 1947, 11 p.

The development of a glass-to-silver-plated steel disk-type seal used in the manufacture of electron tubes designed for high-frequency operation. The plating process produces a layer of silver on steel which satisfactorily withstands high-temperature processing. Tests indicate that the bond between silver and steel is improved when diffusion of silver into iron and iron into silver takes place.

8-61. Copper Plating in Alkanesulphonic Acid Baths. C. L. Faust, B. Agruss, E. L. Combs, and Wayne A. Proell. *Monthly Review*, v. 34, May 1947, p. 541-549.

Plating conditions for depositing copper at current densities of 60 to 1000 asf. from baths based on alkanesulphonic acids. Semibright plate is deposited without the need for addition agents, and it, as well as matte plate, is easily color buffed on wheels or electrolytically. Bright nickel, deposited directly over the semibright copper has good color. Effect of variation in operating factors, as reflected in plating results, is discussed for four sets of plating ranges. (To be continued.)

8-62. Porosity of Electrodeposited Metals. A. E. S. Resarch Project No. 6. Part II. Critical Literature Review. N. Thon and E. T. Addison, Jr. *Monthly Review*, v. 34, May 1947, p. 568-576.

History, methods of demonstration, and evaluation of porosity. (To be continued.)

8-63. Production Clinic for Finishing Die Castings. *Die Castings*, v. 5, May 1947, p. 57-58, 60.

Essential specifications for proper plating of zinc-base die castings; Chrysler specifications for plating of zinc-base die castings and solutions recommended by New Jersey Zinc Co.; mechanical treatments for magnesium die castings; and chemical treatments for aluminum die castings.

8-64. Wartime Plating Developments in England. A. W. Hothersall. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 1-16.

Largely a review of published work; not comprehensive, but confined to those developments with which the author has been personally acquainted. 33 ref.

8-65. Summary of Wartime Research on Plating at the National Bureau of Standards. William Blum. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 16-21; discussion, p. 21-23.

Only projects with which the Bureau had some direct connection.

8-66. Nickel Plating on Steel by Chemical Reduction. Abner Brenner and Grace E. Riddell. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 23-29; discussion, p. 31-33.

Process by which the deposition of nickel is brought about by chemical reduction of a nickel salt with hypophosphites in a hot ammoniacal solution.

8-67. Purification of Rhodium Plating Solutions. Abner Brenner and Walter A. Olson. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 29-31; discussion, p. 31-33.

Method involves precipitation of certain metallic impurities with potassium ferrocyanide.

8-68. X-Ray Diffraction Studies of Electrodeposits. Theodore Voyda. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 33-48; discussion, p. 48.

Diffraction fundamentals; the application of the techniques to examination of lead-indium alloys, tin-copper and lead-tin alloy electrodeposits, nickel and copper flashes on steel, and silver flashes on copper to determine their significance in bonding silver to steel.

8-69. Corronizing Wire Screen Cloth Using Radiant Heating. J. Edward Bemiller and Damon C. Antel. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 75-80; discussion, p. 80-81.

Process used by Hanover Wire Cloth Co., Hanover, Pa., for nickel plating of steel wire cloth.

8-70. Disposing of Plating Room Waste Liquors in Compliance With Stream Pollution Laws. C. J. Lewis. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 81-90.

A general discussion.

8-71. Some Observations on Alkaline Electrotinning. T. G. Timby. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 90-102; discussion, p. 116-117.

Most satisfactory techniques to be used in manufacture of tinplate. The effect of anode contour and design on anode current-density distribution. The effect of making the cathode narrower than the anode.

8-72. Electro Tin-Plating of Wide Steel Strip at High Speed. Samuel S. Johnston and Garold C. Jenison. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 102-115; discussion, p. 116-117.

The development of commercial electrotinning processes. 18 ref.

8-73. Determination of Impurities in Electroplating Solutions. E. J. Serfass. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 181-188.

Colorimetric procedures developed for lead, iron, manganese, chromium, silicon, and cadmium.

8-74. Methods for Testing Adhesion of Electrodeposits. A. L. Ferguson. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 188-199.

A.E.S. committee progress to date. A simple apparatus, depending on use of an adhesive between parts which are to be pulled by the tensile machine and the electrodeposit, is pictured. Various present methods.

8-75. Effect of Surface Finishing of Nonferrous Base Metals on Protective Value of Plated Coatings. Myron B. Diggin. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 206-209.

Research program to be conducted by A.E.S. committee. The effects of finishing procedures on the durability of electroplated coatings on copper-base alloys and on zinc-base die castings are to be evaluated. Deposits are to be limited to copper and bright nickel. Samples will be exposed to rural, industrial, and marine atmospheres, and to accelerated corrosion tests.

8-76. Polarization at Electrodes in Electroplating Processes. A. L. Ferguson. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 215-218.

The effects of polarization and overvoltage on the electroplating process.

8-77. Plating With the Acid Copper Sulphate Solution. George Schore. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 237-243; discussion, p. 243-244.

Rough copper deposits may be formed because of improper choice of plating conditions, imperfections in the cathode surface itself, or adhesion of electrically conductive particles to the cathode. Techniques for avoiding these deposits, and the need for further research.

8-78. A Periodic Chart for Electroplaters. George Dubpernell. *Proceedings of the American Electroplaters' Society (33rd Annual Technical Sessions)*, 1946, p. 244-257.

The discovery of the metallic elements which can be electrodeposited from aqueous solutions. A periodic chart is presented which appears useful for the correlation of information on the electrodeposition of metals. Generalities in connection with ease of deposition, electrode potential, physical properties, structure of deposits, current efficiency. 16 ref.

For additional annotations indexed in other sections, see:

7-180-181-190.

9 PHYSICAL TESTING

9-49. Un Nouvel Appareil de Microdurete Le "Microsclerometre L.C." (**A New Microhardness Measuring Device: The "L.C. Microsclerometer".**) Robert Girschig. *Revue de Metallurgie*, v. 43, March-April 1946, p. 95-112.

The apparatus and possible applications. Although smaller than the ordinary hardness measuring device, this microsclerometer is precise and better adapted to small specimens or fine coatings. Examples of results obtained using the instrument.

9-50. Does Torque Weaken Bolts? H. O. Hill. *Fasteners*, v. 4, no. 1, 1947, p. 10-12.

Tests were made on ⅝ and ¾-in. diameter bolts 11 in. long. Bolts had cut threads and square heads (hot formed) with hexagon nuts. Carbon was 0.15 to 0.24% and threads were class 2, coarse thread, series. The bolts were galvanized. Testing was performed on a 50,000-lb. Riehle lever testing machine. Tension was applied between head and nut by straight pull of testing machine, tightening nut, and combination of the two.

9-51. Monel Cold Upset Collar Studs. V. A. Spoehr. *Fasteners*, v. 4, no. 1, 1947, p. 13-14.

Table presents the result of tests made at the Technological Institute at Northwestern University. Tests were made in a 120,000-lb. Baldwin-Southwark universal tensile testing machine to determine the weakest section of the studs after forming. Loading speeds of 2000 and 5000 lb. per min. were used.

9-52. Généralisation de la Detection de Certaines Fragilités des Aciers. (**Generalization of the Determination of Certain Types of Steel Brittleness.**) Georges Vidal. *Comptes Rendus*, v. 224, Feb. 6, 1947, p. 394-395.

Temper brittleness can be detected by a low-speed bending test or by an impact test at low temperatures if detection of this phenomenon is impossible by impact test at room temperature. It is now shown that the brittleness resulting from tempering may be determined by impact-bending tests at low temperatures using plain polished test specimens.

9-53. A Rapid Method for Accurate Yield Strength Determination Without Stress-Strain Curves. L. J. Ebert, M. L. Fried, and A. R. Toole. *ASTM Bulletin*, March 1947, p. 50-53.

A method developed for obtaining yield strength of nonferrous materials and heat treated steels suitable for a

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Metallic Atoms in Action Is Tri-Chapter Theme

Reported by R. E. Christin
Chief Metallurgist, Columbus Bolt Works

"Metallic Atoms in Action" attracted 192 members and guests to the 9th annual Tri-Chapter meeting of Cincinnati, Columbus, and Dayton Chapters held in Columbus on April 24. Morning plant visitations included a trip to the cyclotron and betatron at Ohio State University, to Battelle Memorial Institute, Jeffrey Mfg. Co., Curtiss-Wright Plant, Columbus Bolt Works Co., and the Buckeye Steel Castings Co.

Following luncheon, addressed by Wes Fesler, head football coach, Ohio State University, the technical session was opened by John Chipman, head of the metallurgical department at M. I. T., who discussed "Atomic Metallurgy".

Showing the "metallography" of uranium at 100 million magnifications, the speaker described the metallurgical principles involved in the preparation of metallic uranium. Diagrammatic pictures of neutrons producing fission followed what could be told of the metallurgy of uranium, plutonium (very toxic in dust form), thorium, beryllium, and other elements which were instrumental in the success of the Manhattan Project. Problems such as prevention of corrosion and control of radioactivity were described by Dr. Chipman, who stated the first law of thermodynamics: "What goes into the furnace must come out—except what stays in".

Dr. Chipman had a grandstand seat at the Baker or underwater test at Bikini, and showed slides of the actual bombing. Dr. Marion L. Pool of Ohio State University followed with a commentary on the movies taken at the Bikini tests, and stirred his audience with the magnitude of the project in which he played an important part.

At the evening session, E. E. Thum, editor of *Metal Progress*, summed up the discussion of the day with a talk on "Practical Implications of Atomic Energy". Recalling the history of power from the invention of the steam engine to the Atomic Age, he said that early sources of mechanical power had developed in private enterprise almost free of specific taxation, yet the other means of power have been taxed more and more heavily. Now that the vast resources of atomic power are under exclusive government control, he believes that in the relatively near future other sources of power may also be nationalized.

Speaking of the military aspects of atomic energy, Mr. Thum said, "The dangers are *now* upon us unless our defense mechanism is instant, alert, and so superior that other nations will not dare to attack us. Effective planning will be needed, looking to a relatively small army, navy and air force of highly trained specialists—professionals."


National Secretary Eisenman (Left, Above) Presents a Ten-Year Certificate to R. E. Christin, Secretary of the Columbus Chapter. At right is John Chipman, who addressed the afternoon session of the annual Tri-Chapter Meeting

Dictators can start wars and clandestine preparation for war whenever they think the time is ripe—democracies have to work in the open. This is the real danger, Mr. Thum believes, in the present lawless world in which we live, amounting practically to international anarchy. Our chief danger is that the majority of Americans will not realize the necessity for defense weapons, and will deny the defense establishment the necessary financial, moral and humanistic support.

W. H. Eisenman, A.S.M. national secretary, also spoke and presented a ten-year certificate to R. E. Christin, Columbus Chapter secretary. Ray T. Bayless, assistant secretary of the society, and A. P. Ford, advertising manager, were guests at the meeting.

single operator without the aid of an automatic load-elongation recorder.

9-54. Sur l'Influence de la Forme et des Dimensions de l'Eprouvette sur le Résultat des Essais de Fatigue. (Influence of the Shape and Dimensions of Test Specimens on the Final Results of Fatigue Tests.) Pierre Laurent. *Comptes Rendus*, v. 224, March 10, 1947, p. 719-721.

Experiments have resulted in establishment of a mathematical relationship among fatigue, tensile, and compressive strengths, and the dimensions of the test specimens. The relationship is also shown to be valid by theoretical calculations.

9-55. Tests for Adhesion and Hardness of Surface Coatings. H. Grinsfelder. *Organic Finishing*, v. 8, April 1947, p. 38-42.

Study of the accuracy and reproducibility of five widely used tests for adhesion and hardness of surface coatings. Tests studied were the Sward hardness rocker, the pencil method, the modified Bell Laboratory mar adhesion test, and the fingernail and knife scratching tests.

9-56. Unique Machine Tests Engine Mount Materials. *Automotive and Aviation Industries*, v. 96, May 1, 1947, p. 42, 74.

Machine to test elastic materials measures the rate, hysteresis loss, and efficiency of a mount; and, under dynamic loading conditions, it can be used to evaluate life expectancy.

9-57. Brass Die Castings. *Product Engineering*, v. 18, May 1947, p. 129.

Die-cast brasses yield consistently higher physical properties than sand-cast test bars. Tensile strengths range from 50,000 to 100,000 psi., with elongations ranging from 5 to 25%. Impact strengths of the common copper-base die-casting alloys are grouped fairly closely around 35 ft-lb. Charpy. (From "High Melting-Point Alloys" by H. K. Barton and L. C. Barton, *Mechanical World and Engineering Record*, July 26, 1946.)

For additional annotations indexed in other sections, see:
3-132-139; **8**-74; **19**-141; **24**-129-130-143.

10 ANALYSIS

10-68. Modern Methods of Gas Analysis. Part II. W. D. Vint. *Metallurgia*, v. 35, March 1947, p. 255-257.

The Orsat gas-analysis apparatus and some hints on its correct maintenance. Particulars of the reagents used and the operation of the apparatus, including a graph indicating the number of cc. of gas which can safely be exploded when its calorific value is roughly known. (To be continued.)

10-69. Applications of the Polarograph to Metallurgical Analysis. Part II. G. W. C. Milner. *Metallurgia*, v. 35, March 1947, p. 265-267.

Three methods of separating copper and zinc, together with the reactions of other alloying elements generally present in brasses and bronzes. Precipitation of zinc by sodium sulphide from an alkaline cyanide medium is recommended when the alloy contains a high percentage of nickel; otherwise potassium iodide is used. The zinc-sulphide precipitation method is recommended for brasses. For traces of zinc in bronzes the copper is more completely removed from the zinc by hydrogen sulphide. In all cases the zinc is finally determined polarographically using an ammonia-ammonium chloride base electrolyte.

10-70. A Note on the Use of Multi-Tip Electrodes in Polarographic Work. J. McGilvery, R. C. Hawkins, and H. G. Thode. *Canadian Journal of Research*, v. 25, section B, March 1947, p. 132-134.

Use of two or more capillaries in parallel to increase cathode surface and thereby increase diffusion current and sensitivity. Each tip gives a diffusion current proportional to its calibration constant, and multi-tip electrodes give diffusion currents proportional to the sum of the capillary constants. Galvanometer oscillations are also reduced considerably by use of multi-tip electrodes.

10-71. Sur une Cause d'Erreur dans la Méthode de Dosage par Fusion dans le Vide des Gaz Dissous dans l'Aluminium. (Concerning a Source of Error in the Vacuum-Fusion Method of Determining Gases Dissolved in Aluminum.) Léon Moreau and Georges Chaudron. *Comptes Rendus*, v. 224, March 17, 1947, p. 829-831.

A comparative investigation of the vacuum-fusion method and other gas-determination methods. The source of error seems to be in condensation of evaporated aluminum on the cold part of the apparatus followed by immediate absorption of this aluminum.

10-72. Emission Spectroscopy and Some of Its Industrial Applications. J. E. Scott. *Steel Processing*, v. 33, April 1947, p. 216-218.

Its use in qualitative and quantitative analysis.

10-73. New Titrimetric Methods for Thorium. Charles V. Banks and Harvey Diehl. *Analytical Chemistry*, v. 19, April 1947, p. 222-224.

A new oxidimetric method is based on the precipitation of thorium as the normal molybdate followed by the reduction and titration of the molybdenum equivalent to the thorium. This method has been applied to the separation of thorium from calcium and uranium and to the determination of molybdenum by reversal. A new electrometric titration method. 20 ref.

10-74. Colorimetric Method for the Determination of Cobalt Stainless Steel. Harry M. Putsche and W. Francis Malooly. *Analytical Chemistry*, v. 19, April 1947, p. 236-238.

Method uses Vogel's reaction in which a blue complex, sodium cobaltothiocyanate is formed on addition of sodium thiocyanate to a cobaltous solution. The intensity of the blue complex is measured colorimetrically.

10-75. Rapid Gravimetric Determination of Silicon in Aluminum Alloys. Philip Lisan and Henry L. Katz. *Analytical Chemistry*, v. 19, April 1947, p. 252-253.

Method suitable for amounts exceeding 1.5%. An acid attack is employed using phosphoric, nitric, and sulphuric acids. The precision and accuracy of the new method are determined by a statistical study of the data. 19 ref.

10-76. Second Annual Analytical Symposium. Sponsored by the Analytical Division, Pittsburgh Section, American Chemical Society. *Analytical Chemistry*, v. 19, April 1947, p. 284-285.

Abstracts include the following papers: Polarographic Determination of Nickel. Application to Catalyst Material, by R. O. Clark; Phosphoric-Perchloric Acid Oxidation of Manganese, by Ernest Buyok; Analysis of Certain High-Temperature Alloys, by E. W. Beiter; Analysis With an X-Ray Spectrometer, by J. C. Redmond; Routine Spectrographic Analysis of Solders and Babbitts, by G. W. Wiener and A. W. Danko.

10-77. Spectrochemical Analysis by the Copper Spark Method. Mark Fred, Norman H. Nachtrieb, and Frank S. Tomkins. *Journal of the Optical Society of America*, v. 37, April 1947, p. 279-288.

A system in which 0.1 ml. of a hydrochloric acid solution of the sample is evaporated on the ends of a pair of flat-topped copper electrodes which are then excited in a spark. Absolute sensitivities for different elements ranging from 10^{-10} to 10^{-8} gr. have been obtained. The lower limits measurable by visual comparison with standard plates are given for 64 elements.

10-78. Evaluating Pickling Acid Inhibitors. E. L. Colichman, R. C. Thielke, and B. J. Cotey. *Iron Age*, v. 159, April 24, 1947, p. 55-57.

An easily performed colorimetric test method that has been successful in obtaining reproducibility to within 3% accuracy; and the analytical procedure to be followed in performing the evaluation test.

10-79. The Determination of Phosphorus in Austenitic Chromium-Nickel Steels. *Journal of the Iron and Steel Institute*, v. 155, March 1947, p. 373-391.

Important features of the recommended method are: a high nitric acid concentration to prevent the inhibiting effects of titanium and vanadium and to prevent formation of insoluble zirconium phosphate; the recovery of occluded phosphorus in the presence of tungsten, columbium, and zirconium by precipitation of magnesium ammonium phosphate from ammoniacal solution, assisted by the addition of arsenate; elimination of arsenic and tin by treatment with hydrobromic acid.

10-80. Spot Tests for the Detection of Alloying Elements in Zinc-Base Alloys. B. S. Evans and D. G. Higgs. *Analyst*, v. 72, March 1947, p. 101-105.

Tests for the detection of copper, aluminum, antimony, tin, cadmium, and lead in zinc-base alloys.

10-81. Spot Tests for the Detection of Alloying Elements in Lead-Base Alloys. B. S. Evans and D. G. Higgs. *Analyst*, v. 72, March 1947, p. 105-109.

Tests for the detection of tin, antimony, cadmium, silver, arsenic, and bismuth in lead-base alloys.

10-82. The Titration of Minute Amounts of Nickel. B. S. Evans. *Analyst*, v. 72, March 1947, p. 110.

Modification of method published in v. 71, 1946, p. 457, which eliminated difficulty encountered with solutions containing less than 0.0001 g. Ni.

10-83. Modern Methods of Gas Analysis. Part III. Analysis of Blast-Furnace Gas. W. D. Vint. *Metallurgia*, v. 35, April 1947, p. 294-296.

Modified Orsat apparatus and the portable Orsat. The method of taking a flue-gas analysis. A brief description is given of the Hempel apparatus.

10-84. Applications of the Polarograph to Metallurgical Analysis. Part II. Polarographic Methods for the Determination of Zinc in Copper Base Alloys. (Continued.) G. W. C. Milner. *Metallurgia*, v. 35, April 1947, p. 307-309.

Precipitation method for determination of zinc in brasses.

10-85. Infrared Absorption Analysis of Gases and Vapors. Part II. R. Quarendon. *Petroleum*, v. 10, April 1947, p. 78-79, 89.

The general features of limited-radiation analyzers.

10-86. Lead in Zinc Alloys. F. L. Jameson. *Metal Industry*, v. 70, April 18, 1947, p. 272.

Method for routine determination to fine limits.

For additional annotations indexed in other sections, see:
4-53; **8**-73; **27**-89.

11 INSTRUMENTS Laboratory Apparatus

11-47. Electrolytic Polishing of Metallographic Sections. L. P. Zaitzeva and L. J. Popilov. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 194-195.

A comprehensive series of experiments on polishing of a number of constructional carbon steels, high and low carbon, and high and low alloy

(Turn to page 32)

Surface Hardening Of Steel Traced

Reported by Dow M. Robinson
New England Metallurgical Corp.

A trip back to the Stone Age started off a most interesting talk on "The Surface Hardening of Steel" presented by A. Dudley Bach, president of the New England Metallurgical Corp., at the April meeting of the Boston Chapter ⊕. The talk was interspersed with humor, slides and movies; it traced the hardening of steel from the earliest times up to present-day practice.

Mr. Bach first considered the various methods by which we take a 0.10 to 0.30% carbon steel and change the chemistry of the surface layers of the steel to a depth of from 0.002 to 0.125 in. or more. Carbon may be added to the surface layer of the steel, nitrogen may be added, or a combination of carbon and nitrogen. Methods of adding carbon are *(a)* by the time-honored use of solid carburizing compounds, *(b)* by the use of gas and liquid carburizing mediums, and *(c)* by molten carburizing salt baths.

The speaker described the chemistry involved in each of these processes and the various types of furnaces available today. Advantages and disadvantages of each method were also enumerated.

The second portion of the talk was devoted to methods of surface hardening steels (particularly those containing 0.40% carbon or more) by the application of local heat, such as the oxy-acetylene flame or by induction heating. These two methods have made tremendous forward strides in recent years, and can now be just as well controlled as carburizing and cyaniding.

Kodachrome slides and movies illustrated actual pieces being heat treated by the methods described in the talk.

Technical Chairman Wm. L. Badger of General Electric Co. introduced the speaker and also conducted a lively question period. Coffee speaker was Dr. Sidney Farber, chairman, division of laboratories, Children's Hospital.

400 Attend Lectures in Buffalo Educational Series

Reported by G. F. Kappelt
Assistant Metallurgist, Bell Aircraft Corp.

The 1946-1947 educational lecture series of the Buffalo Chapter ⊕ consisted of four lectures on *(a)* the alloying elements; *(b)* the carbon and alloy steels; *(c)* tool, stainless, and special steels; and *(d)* nonferrous and light metals. This series, attended by a total of well over 400 members and guests was given by Walter J. Conley of Carpenter Steel Co.

These subjects were presented by Mr. Conley from a "use" rather than from a physical property standpoint. In this manner, all long tabulations of physical properties were avoided and instead the reasons why, the hows, and the whats needed were stressed.

Badger, Bach and Farber at Boston

W. L. Badger, Technical Chairman (Left), A. Dudley Bach, Principal Speaker (Center), and Dr. Sidney Farber, Coffee Speaker (Right), Exchange Views After the Boston Chapter Meeting in April. (*Photo by H. L. Phillips*)

steels. (Abstracted from *Zavodskaja Laboratorija*, no. 7 and 8, 1946, p. 679-692.)

11-48. A New Method of Studying the Structure of Alloys by Magnetic Analysis. P. T. Hobson. *Nature*, v. 159, March 29, 1947, p. 436.

In testing of metal wires for ferromagnetism, using a cathode-ray oscilloscope, marked irregularities were noted in the curves of external field strength of rate of change of magnetic intensity, and in the hysteresis loop. It is believed that the irregularities are caused by structure inhomogeneity, hence use of the phenomena is suggested for study of alloy structure.

11-49. Preparation and Uses of Silica Replicas in Electron Microscopy. Charles H. Gerould. *Journal of Applied Physics*, v. 18, April 1947, p. 333-343.

The preparation of silica replicas and substrates and their many and varied uses. A method for preparing silica replicas of specimens which cannot be subjected to the temperatures and pressures of the ordinary technique consists of applying a polystyrene lacquer to the specimen surface in place of the conventional molding. Technique of dispersing the powder in an ethyl cellulose lacquer and depositing upon a silica substrate. Several other techniques included.

11-50. Trends in Electric Gaging Methods. Howard C. Roberts. *Instruments*, v. 20, April 1947, p. 326-330.

The development of electrical gaging systems. A general-purpose amplifying system designed by the author is applicable to pointer-type indicating instruments, low-impedance magnetic oscillographs, or cathode-ray oscillographs. Need for improvements along certain lines.

11-51. Surface Finish Measurement Instrumentation. James A. Broadston. *Instruments*, v. 20, April 1947, p. 374-377.

Advantages for production of metal parts and equipment. (To be continued.)

11-52. Locke Insulator Makes Wide Usage of Industrial Instruments. C. W. Bowden. *Instrumentation*, v. 2, April-May 1947, p. 3-5.

Several applications of instruments, including drying ovens, continuous kilns, alloy pots, and metallizing furnaces in the plant of Locke Insulator Corp., Baltimore.

11-53. Casting Quality Controlled by New Dilatometer. Carl M. King. *Instrumentation*, v. 2, April-May 1947, p. 25.

Use of new Dietert dilatometer and Brown electronic potentiometer in control of the sand used for molding in the metal foundry.

11-54. Basic Characteristics of Useful Industrial Laboratory Instruments. J. S. Buhler. *Iron Age*, v. 159, May 1, 1947, p. 58-61.

Tabulation of the most prominent or most used types giving the principles, construction, and outstanding uses.

11-55. Ultrasonic Measurement of Wall Thickness in Diesel Cylinder Liners. Francis W. Struthers and Horace M. Trent. *Journal of the Acoustical Society of America*, v. 19, March 1947, p. 368-371.

Modifications developed in order to adapt the Sonigage to the quick inspection of diesel cylinder liners. A method of introducing ultrasonic vibrations from a conventional flat-crystal probe into a curved surface and an adaptor for determining thickness by interpreting the harmonics response have proven to be useful. Use of technique yields much valuable information concerning the relative homogeneities of the castings.

11-56. De Beteekenis Van Het Electronen-Microscoop Voor Het Metaalonderzoek. (Application of Electron Microscope in Metallurgical Research.) Part II and III. H. C. J. De Decker. *Metalen*, v. 1, March 1947, p. 113-117; April 1947, p. 139-144.

Surveys the different techniques of electron microscopic examination with special reference to their application in metallurgical research. Different types of electron microscopes, and their metallurgical use.

11-57. Interferometers. *Automobile Engineer*, v. 37, April 1947, p. 137-138.

Hilger instruments for comparative or absolute measurements of wavelengths of light.

11-58. A General-Purpose Debye-Scherrer Camera and Its Application to Work at Low Temperatures. William Hume-Rothery and D. J. Strawbridge. *Journal of Scientific Instruments*, v. 24, April 1947, p. 89-91.

An apparatus has been devised for accurately controlling the temperature of the specimen between room temperature and −110° C. Lattice spacing measurements of aluminum at temperatures down to −97.5° C. are in agreement with those calculated from the coefficent of expansion of the bulk metal.

11-59. Tracer-Point Sharpness as Affecting Roughness Measurements. D. E. Williamson. *Transactions of the American Society of Mechanical Engineers*, v. 69, May 1947, p. 319-323.

Test procedure proposed to show the differences in average roughness readings that are obtained on a variety of specimens using tracer points of different sharpness. Four diamond points were obtained in mounts to suit them for use in the common type of profilometer tracer. Measurement of average roughness on metal surfaces finished with abrasives can be satisfactorily carried out by tracer-point methods. Regardless of the smoothness of the piece, a tip radius of 0.0005 in. is adequate.

For additional annotations indexed in other sections, see:

6-87; 7-187-188; 8-68; 10-71; 12-76-84; 20-252; 21-41; 27-89.

12 INSPECTION AND STANDARDIZATION

12-74. Much Activity in Standardization and Research Shown at the 250 Sessions Held During A.S.T.M. Committee Week. *ASTM Bulletin*, March 1947, p. 30-41.

Work of the various standards committees.

12-75. Taper Production, Gaging and Gages. W. Richards. *Machinery (London)*, v. 70, March 27, 1947, p. 309-312.

Procedures for measuring and inspection of gage blocks for taper parts.

12-76. The X-Ray Storage Properties of the Infrared Storage Phosphor and Application to Radiography. O. E. Berg and H. F. Kaiser. *Journal of Applied Physics*, v. 18, April 1947, p. 343-347.

An application whereby the expense and trouble of X-ray film processing may be partially or completely eliminated. One feature of this method is the complete removal of harmful X-radiation. The possibility of a new field of radiography in "flash fluoroscopy" is also suggested. Graphs and charts exhibit the characteristic behavior of infrared phosphors to X-ray energy and photographs and radiographs compare radiography with phosphorography.

12-77. Constructing a Multiple Exposure Chart for X-Rays. *Steel*, v. 120, April 28, 1947, p. 103-104, 134.

Method for preparing a sliding scale exposure chart for X-ray and gamma-ray exposures so that data available on several existing charts can be incorporated in one chart for convenient use.

12-78. Controlling a Heat of Steel. Ralph G. Paul. *Western Machinery and Steel World*, v. 38, April 1947, p. 78-81, 108-109, 116.

Quality-control methods in Columbia Steel Co.'s Pittsburg Works, where nearly 400,000 tons of steel a year are made by the basic openhearth process. Methods incorporate the most modern techniques.

12-79. Utilization of Supersonics for the Testing of Materials. H. Bömmel and R. V. Baud. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 176-177.

Fundamental principles of the use of ultrasonic waves for nondestructive testing of materials. Illustrated by several examples. (Condensed from *Zeitschrift fur Schweisstechnik*, v. 36, no. 9, Sept. 1946, p. 185-187; no. 10, Oct. 1946, p. 207-209.)

12-80. Surface Defects in Steel Bars for Bolt Manufacture and Wiredrawing. R. Hoffmann. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 194.

Invisible defects due to unsatisfactory founding or rolling control. Five different types of defects—scratches, cracks, laminations, fissures, and small flaws—analyzed by inspection, and mechanical and chemical tests. (Abstracted for *Revue Universelle des Mines, de la Metallurgie, des Travaux Publics*, Belgium, v. 2, no. 9, 1946, p. 405-411.)

12-81. Industrial Applications of Electronic Techniques. (Continued.) H. A. Thomas. *Engineer*, v. 183, April 4, 1947, p. 295-297.

A survey of electronic eddy currents; dielectric heating; electronic counting and inspection devices. 20 ref.

12-82. Hidden Danger in Lap Joints. Harry M. Spring. *Power*, v. 91, May 1947, p. 103.

Three ways to investigate suspicious joints.

12-83. S.A.E. Metal Numbers Explained. *Industry and Power*, v. 52, May 1947, p. 92, 108.

A simplified table to aid the designer in specifying ferrous alloys suitable for his needs.

12-84. Check Right Angles by Optics. Henry Harrison. *American Machinist*, v. 91, May 8, 1947, p. 110.

Right angles can be checked to within a few seconds of arc by a method widely used in prism manufacture. Applications range from inspecting instrument-maker's squares to the squareness of a machine spindle.

12-85. How to Analyze Production Rejects. Eugene Goddess. *American Machinist*, v. 91, May 8, 1947, p. 111-113.

Shrinkage analysis tells what is wrong with rejected parts and indicates method of attack to reduce or eliminate variables.

12-86. Hardenability—A Revolutionary Basis for Steel Specifications. Fred P. Peters. *Scientific American*, v. 176, May 1947, p. 210-213.

Selection and specification of steels on the basis of hardenability rather than of composition.

12-87. Inspector's Approach to Radiographs of Mild Steel Butt Welds. E. Fuchs, L. Mullins, and S. H. Smith. *Transactions of the Institute of Welding*, v. 10, Feb. 1947, p. 19-36.

A short training course was given to a number of engineering inspectors to help them assess the quality of welds by the interpretation of radiographs. Work was confined to material 1 in. thick, but the findings would apply fully for mild steel up to 1½ in. thick, one example of this thickness being included.

12-88. Strain Gage Testing. *Railway Mechanical Engineer*, v. 121, May 1947, p. 256-257.

Use by the Santa Fe for measuring

(Turn to page 34)

Johnson Compares Forging, Casting And Welding for Aircraft Fabrication

Reported by Donald J. Henry

General Motors Research Laboratories

Pointing out that all three major fabricating methods have an important place in the production of airplanes, J. B. Johnson, chief of the Materials Laboratory, Engineering Division, Wright Field, presented a highly informative paper at the March meeting of the Detroit Chapter on "Forged, Cast or Welded Structures as Applied to Aircraft".

Either a casting, forging or welded assembly will prove satisfactory for many parts in the airframe and power plant, and choice may be determined by other than metallurgical considerations, such as processing economics. From the standpoint of design and metallurgy, the primary consideration is adequate strength.

Both castings and forgings are available in a wide range of chemical composition, and will have equal mechanical properties with suitable heat treatment. However, if the directional properties of forgings are to be realized, cast metal has lower ductility, although sufficient for many applications. Other purposes of forging are to obtain close dimensions, to close up internal cavities, and to refine the grain. Forging is preferred where stresses are high at the root of the tooth or impact loading is severe.

Centrifugal casting has been used successfully for cylinder barrels, axles, propeller hubs, bearings, armor and strut castings. The rapid and uniform cooling rate produces greater soundness and finer grain with improved ductility as compared to static castings. Centrifugal casting defects occur more often at the surface than in the interior, and thus a sound part can be produced with a minimum amount of machining.

Welding is used extensively in joining thin metal components for the assembly of wings and bodies, and may be the only satisfactory fabrication method where high physical properties are desired in hollow parts and monocoque sections.

In general, castings have higher short-time tensile strength, stress-rupture and creep properties than forgings as the service temperature approaches the top for a particular alloy. For low and intermediate temperatures, forgings are stronger.

Johnson warned against relying solely upon nondestructive tests to determine aircraft quality. Forging defects such as laps, bursts and overheating are not easily detected by X-ray. Magnaflux and supersonic devices indicate cracks and lack of bond but the detrimental effect can be judged only qualitatively. Quantitative results can only be obtained by simulated service tests of finished parts with statistical evaluation of the data.

J. B. Johnson

As a general rule, Mr. Johnson advised that when loads are primarily static or the vibratory stress range is narrow, either a casting, welded assembly or forging is satisfactory. When maximum stress in a loading cycle approaches the endurance limit, wrought materials of the highest quality should be specified. Analysis of stresses resulting from applied loads is complicated, and often only experience based on service records can serve as the basis for selection.

LaQue Surveys Stainless Steel Selection at Montreal

Reported by R. Peck

Assistant Metallurgist

The Steel Co. of Canada, Ltd.

A comprehensive survey of the selection of stainless steels by F. L. LaQue of the International Nickel Co. of Canada featured the March 3rd meeting of the Montreal Chapter ⊕.

Mr. LaQue described the common grades of rolled stainless steels, referring to them by their American Iron & Steel Institute type numbers, and pointed out that the cast alloys have the same general characteristics although they are identified differently.

The essentials of Mr. LaQue's talk were reported in the March issue of *Metals Review*, page 35.

The coffee talk consisted of two films presented by courtesy of the International Nickel Co. of Canada, Ltd. They were "Nickel Tales" showing the diversified uses of nickel, and "This Changing World" which illustrated the nickel industry in Canada.

forces exerted by trains on track structure and for testing locomotive and car parts.

12-89. Black Light Inspection Cuts Tool Costs. Franklin Catlin. *Machine and Tool Blue Book,* v. 43, May 1947, p. 159-160, 164, 166, 168, 170, 172.

General application and theory of black light inspection.

For additional annotations indexed in other sections, see:
11-50-55; 14-139; 19-141; 21-40; 22-241; 27-104.

13 PYROMETRY Temperature Control

13-18. Obtaining of Linear Furnace Temperature Increases. V. F. Oreshko. *Journal of Applied Chemistry (U.S.S.R.),* v. 19, no. 8, 1946, p. 849-851. (In Russian.)

A new method developed by N. M. Karaviev for obtaining linear increases in furnace temperatures, which is often necessary, especially in research. The method was investigated theoretically and its application to a number of research problems indicated.

13-19. Un Régulateur de Température de Précision. Application a un Calorimètre Adiabatique. (A Precision Temperature Controller. Application of an Adiabatic Calorimeter.) Louis Weil. *Comptes Rendus,* v. 224, March 17, 1947, p. 810-812.

A newly developed temperature controller having direct regulation. All mechanical drives are replaced by a system of photoelectric cells with a galvanometer. In connection with a calorimeter this control has measured heat generated at rates of less than 0.002 cal. per min.

13-20. Thermocouple Protecting Tubes. *Materials & Methods,* v. 25, April 1947, p. 143.

Recommendations for various atmospheres and media.

13-21. Platinum Thermocouples. *Metal Industry,* v. 70, April 18, 1947, p. 266, 271.

Research progress in calibration and contamination in service.

13-22. Instrumentation of Openhearth Steelmaking Furnaces. *Metallurgia,* v. 35, April 1947, p. 278.

Suggests list of control instruments for new steelmaking installations and the modernization of existing installations.

For additional annotations indexed in other sections, see:
11-52; 18-88; 24-134.

14 FOUNDRY PRACTICE

14-118. De Koepeloven. (Cupola Furnaces.) J. S. Abcouwer. *Metalen,* v. 1, March 1947, p. 118-122.

Chemical process in cupola furnaces and factors involved. Optimum conditions for smelting based on experimental data.

14-119. Production of Magnesium Sand Castings. G. B. Partridge. *Metallurgia,* v. 35, March 1947, p. 241-245.

Technique involved in melting of magnesium alloys. The types of fluxes used; the melting units, with special reference to melting pots; preparation of the metal for casting, including superheating, grain refinement and the gas effect.

14-120. Patternmaking. A New Machine for Cutting Irregular Shapes. B. Levy. *Foundry Trade Journal,* v. 81, March 27, 1947, p. 239-244.

Economical machining and easier production of patterns particularly for irregular-shaped work.

14-121. Foundry Practice. H. W. Lownie, Jr. *Metals Review,* v. 20, April 1947, p. 5-8.

Developments during the past year as described in the literature. Core and sand binders; dielectric heating; research; improved working conditions and mechanization; improved riser techniques; solidification of metals; precision castings; cast phenolic resins for patterns.

14-122. Equipment and Products for the Foundry Industry. *Metals Review,* v. 20, April 1947, p. 9-11, 14-15, 17.

The more important innovations offered commercially during 1946. Feeding compounds; furnaces; refractories; centrifugal casting; precision casting; shakeouts; coremaking equipment; sand preparation; molding equipment; dust control.

14-123. Aluminum Fluxing and Melting Practice. *Modern Metals,* v. 3, April 1947, p. 18-23.

The various fluxing methods for molten aluminum, permanent-mold and die-casting melting practice, metal charging, and furnace operations.

14-124. Core Binders and Baking. Part II. *Light Metal Age,* v. 5, April 1947, p. 12-15, 32.

Properties of the oils used in wet binders, dry binders, and miscellaneous binders. Techniques of core-sand mixing and core baking.

14-125. How the Ford Rouge Foundry Handles Hot Metal for Continuous Pouring. W. G. Patton. *Iron Age,* v. 159, April 24, 1947, p. 40-43.

The flow of the molten metal from the blast furnace and cupola, through the mixers, electric furnaces, and air furnace to the mold to provide a continuous supply of metal, closely controlled as to composition and temperature, for pouring up to 6000 blocks in 16 hr.

14-126. Centrifugal Casting Copper-Spun Rotors. G. A. Anderson. *Steel,* v. 120, April 28, 1947, p. 96-97, 126, 129.

Procedure followed by Fairbanks, Morse & Co. to prepare steel rotor and stator laminations for the casting operation. Casting technique.

14-127. Adopts Chemically Coated Molding Sand. William G. Gude. *Foundry,* v. 75, May 1947, p. 66-71.

The first foundry to make commercial use of chemically coated molding sand, Lynchburg Foundry Co., reports important benefits in operating practice and lower costs resulting from this new process.

14-128. Making a 232-Ton Steel Casting. *Foundry,* v. 75, May 1947, p. 78-79.

How largest and heaviest casting was made for the frame of a 6000-ton capacity, high-speed mechanical forging press by United Engineering & Foundry Co.

14-129. Unsoundness Caused by Gases in Copper-Base Alloys. L. W. Eastwood and J. G. Kura. *Foundry,* v. 75, May 1947, p. 80-82, 200, 202, 204, 206, 208.

First of a series based on investigations at Battelle Memorial Institute sponsored by the Non-Ferrous Ingot Metal Institute. Various types of unsoundness encountered and their causes. Problems requiring solution.

14-130. What Kind of Patterns? (Concluded.) *Foundry,* v. 75, May 1947, p. 86-89.

The proper selection of pattern equipment for production of castings in long production runs.

14-131. Pours Engine Castings in Dry Sand Molds. Pat Dwyer. *Foundry,* v. 75, May 1947, p. 90-93, 112.

Foundry facilities and practices of the Chicago Pneumatic Tool Co. at Franklin, Pa. General features. (To be concluded.)

14-132. Wisconsin Conference. Technical Discussion. Edwin Bremer, William G. Gude, Erle F. Ross, and George A. Pope. *Foundry,* v. 75, May 1947, p. 130, 132, 135, 143.

Reports on technical papers presented at the tenth annual Regional Foundry Conference of the Wisconsin Chapters, A.F.A., and the University of Wisconsin.

14-133. Formulas for Determining the Weights of Castings. (Concluded.) *Foundry,* v. 75, May 1947, p. 139.

Weights of spherical segments of one and of two bases; weights of sand bodies from dimensions; weight of a spoked fly wheel; finding the center of gravity of irregular figures.

14-134. Modified Melting Practice Improves Bronze Pressure Castings. S. W. Wysocki. *Iron Age,* v. 159, May 1, 1947, p. 47-49.

Improved structure and properties of bronze pressure castings resulting from the use of a cover compound and a degasifier in addition to the usual deoxidizer. A series of tests was run to determine the optimum amounts of cover compound and degasifier required to obtain the most beneficial effects. Cost of the additions and melting procedures used.

14-135. Mechanized Melting Methods for Foundries. A. W. Gregg. *Iron Age,* v. 159, May 8, 1947, p. 60-65.

The latest developments in methods and equipment for the mechanization of ferrous and nonferrous melting and the advantages and disadvantages of various types of equipment. How mechanized melting procedures not only reduce operating costs but also improve the quality of the metal.

14-136. A.F.A. Annual Meeting. *Iron Age,* v. 159, May 8, 1947, p. 80-86.

Operating problems and new techniques.

14-137. The Production of Cast Crankshafts. R. B. Templeton. *Institution of Automobile Engineers Journal,* v. 15, March-April 1947, p. 231-249.

Production and design of cast automotive crankshafts. Properties of available materials, dimensional tolerances, comparative production times for steel and cast iron crankshafts, heat treatment, and foundry techniques.

14-138. A Survey of Precision Casting. J. N. Read. *Metallurgia,* v. 35, April 1947, p. 275-278.

Foundry technique of the various precision processes, working limits, and progress difficulties. A survey of present-day production and expected applications.

14-139. The Manufacture of Magnesium Sand Castings. G. B. Partridge. *Metallurgia,* v. 35, April 1947, p. 279-284.

Following cleaning and before being despatched, magnesium castings are given a very thorough inspection which embraces examination for surface flaws and cracks, dimensional checking, X-ray inspection by radiography, and metallographic examination for grain size and heat treatment efficiency. A fracture test is carried out on a percentage of castings produced in special cases, when called for by the customer.

14-140. Some Jobbing Foundry Methods. Tubal Cain. *Iron and Steel,* v. 20, April 1947, p. 128.

Use of the old casting as a pattern.

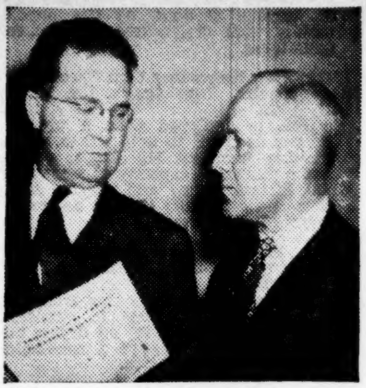
14-141. Cast Iron and Steel. (Continued.) Ernest C. Pigott. *Iron and Steel,* v. 20, April 1947, p. 133-135.

Influence and commercial applications of manganese and molybdenum. (To be continued.)

14-142. Improvements in Hollow Sticks and Billets by Casting Onto Metal Cores.

(Turn to page 36)

Give Lecture Course



Myron Nestor (Left) and C. E. Sims

Reported by Elmer T. Carlson

Isaacson Iron Works

An intensive three-day educational course on "What Steel Shall I Use? Where? When? Why?" was presented before the Puget Sound Chapter ⊛ on March 31, April 1 and 2, by C. E. Sims and Myron Nestor of Battelle Memorial Institute. Attendance at the course was approximately 350.

Mr. Sims conducted the first half of the course, lecturing on nomenclature of steel, specific effects of alloys, and carbon steels. In his part of the presentation Mr. Nestor covered alloy steels, stainless, and toolsteels.

Movie Gives Five Reasons For Powder Metallurgy

Reported by Louis Malpoker

Lincoln Engineering Co.

Speaking on "Industrial Applications of Powder Metallurgy" at the March meeting of the St. Louis Chapter ⊛, John D. Shaw, assistant director of research at Stevens Institute of Technology, covered much the same ground as reported in the May issue, page 27.

Professor Shaw stated that powder metallurgy is no cure-all to every metallurgical problem and does have certain limitations. However, the field of applications is wide, and five good reasons for using powder metallurgy were graphically explained by means of a movie film. These reasons are: *(a)* that nonalloyable elements can be used; *(b)* that metals and nonmetals can be combined; *(c)* that metals with too high a melting point for casting can be used; *(d)* that unique structures can be obtained; and *(e)* that mass production methods are possible.

Jennings Goes to Toronto

E. G. Jennings ⊛ has been appointed sales manager of Metals and Alloys Limited, Toronto, Canada. He was previously employed by Dominion Engineering Works Limited and was on the executive committee of the Montreal Chapter ⊛.

Hardenability Criteria Simplify Steel Control

Reported by Knox A. Powell

Research Engineer
Minneapolis-Moline Power Implement Co.

"Hardenability Criteria" and the simplification of design and control made possible by recent hardenability research formed the subject of an interesting talk before the Northwest Chapter ⊛ on April 8. Speaker was John M. Hodge, research associate on steel heat treatment for Carnegie-Illinois Steel Corp.

Mr. Hodge discussed the relationships between microstructure and mechanical properties as a basis for the choice of microstructural criteria of hardenability. The superior properties of tempered martensite were emphasized, and Mr. Hodge pointed out that these are dependent only upon hardenability and are a function of alloy content only insofar as the alloys affect transformation rates and thereby the hardenability.

The relationships between the full-martensite criterion, and criteria based on mixtures of martensite and upper bainite or pearlite ranging from 50 to 95% martensite, were discussed. Criteria based on 90 to 95% martensite would be suitable for many applications and would necessitate much less alloy than the full martensite criterion. The familiar 50% martensite criterion, however, represents a considerable deviation from optimum properties.

The properties of structures other than tempered martensite were also discussed and lower bainite was suggested as an alternate criterion for martensite, fine pearlite as a criterion for optimum properties in steels that must be used in the pearlitic condition, and coarse pearlite as a criterion for machinability in medium-carbon steels.

W. T. Pell-Walpole. *Foundry Trade Journal*, v. 81, April 10, 1947, p. 285-293.
Experience of the Tin Research Institute in studying the problems of using chill cores with the object of applying degassing and slow pouring techniques developed for chill-cast bronze to improve the quality of cored sticks and billets.

14-143. Making a Light Alloy Snap Flask. J. A. McIntosh. *Foundry Trade Journal*, v. 81, April 17, 1947, p. 313.
Cope-pattern and drag-pattern construction. Molding method employed.

14-144. Die Casting in Aluminum Bronze. *Machinery (London)*, v. 70, April 24, 1947, p. 437.
Method gives a reasonable measure of control on a material which is subject to wide variations when made from virgin metals.

14-145. Lightweight Gasoline Engines Made From Die Castings. R. P. McCulloch. *Iron Age*, v. 159, May 15, 1947, p. 52-56.
Factors influencing the choice of die castings in the design of a new type lightweight engine, including such considerations as a substantial reduction in machining operations, lower scrap losses, and the possibility of employing light, inexpensive machine tools, and greater flexibility for design changes. Major manufacturing and assembly operations in the production of McCulloch motors at a rate of 10,000 per month.

For additional annotations indexed in other sections, see:

2-85-87; **4**-59; **9**-57; **11**-53; **20**-241; **24**-119-121-122; **25**-66.

15 SALVAGE AND SECONDARY METALS

15-15. German Practice in Refining Secondary Aluminum. James T. Kemp. *Metals Technology*, v. 14, April 1947, T. P. 2143, 14 p.
Some interesting and rather unusual processes for refining impure aluminum derived from scraps were found by American and British investigators.

15-16. Salvaging Oversized Parts by an Acid Etch. Donald A. Baker. *Machinery*, v. 52, May 1947, p. 166.
Corrective measures for three very expensive crankshafts that were 0.001 in. oversize on the splined end as the result of nitriding.

For additional annotations indexed in other sections, see:

22-231-235-251; **23**-154

16 FURNACES AND FUELS

16-55. Essential Considerations in Furnace Usage and Design. Herbert Southern. *Metallurgia*, v. 35, March 1947, p. 227-232.
The influence upon fuel consumption of the characteristics of a furnace and of the factors inherent to the heating process. A mathematical approach by which thermal characteristics can be predicted with a maximum degree of accuracy.

16-56. The Infrared Gas Burner. L. Sanderson. *Metallurgia*, v. 35, March 1947, p. 239-240.
Some examples of actual infrared burner applications show how widely this process can be adopted industrially.

16-57. Self-Coking Electrodes for Arc Furnaces. L. I. Levy. *Engineers' Digest (American Edition)*, v. 4, April 1947, p. 158.
Three types of electrodes developed in Russia during the war which do not require a preliminary baking or coking process and the method for their production, installation, and use. (Condensed from *Vestnik Mashinostroenia*, no. 1, 1946, p. 41-45.)

16-58. Mercury-Arc Frequency Changing Equipment for Induction Heating. S. R. Durand. *Iron and Steel Engineer*, v. 24, April 1947, p. 102-108; discussion, p. 108-110.
The principles of the mercury-arc converter, especially as applied to induction heating. Advantages and limitations for induction hardening, melting, and forging.

16-59. Foundries and Forge Shops Reduce Heat Treating Costs. Kenneth Rose. *Materials & Methods*, v. 25, April 1947, p. 100-102.
Comprehensive studies made by three Milwaukee plants of the gains made by installation of high production furnaces.

16-60. Controlled Furnace Atmospheres. Part II. A. G. Hotchkiss. *Steel Processing*, v. 33, April 1947, p. 240-242.
Two hot charcoal converter methods and another type of converter employing endothermic reaction where air-gas mixtures of very low ratio are completely reacted over a catalyst which is externally heated. Relatively simple setup of this type of equipment. Analysis, cost of production, and applications of various atmospheres.

16-61. An Experimental Furnace for the Investigation of Openhearth-Furnace Combustion Problems. Part I. Description of Plant. A. H. Leckie, J. R. Hall, and C. Cartlidge. **Part II. The Effects of Gas Rate, Port Size, Air Gas Ratio, Furnace Pressure, and Gas Calorific Value.** A. H. Leckie, J. F. Allen, and G. Fenton. *Journal of the Iron and Steel Institute*, v. 155, March 1947, p. 392-422.
An experimental furnace specially designed for the investigation of some of the variables affecting openhearth-furnace fuel efficiency and rate of melting. Serious experimental difficulties associated with operation at melting temperatures have been avoided by conducting the experiments at a lower temperature, the heat transferred to the hearth being measured by calorimeters. The effects of gas rate, port size, air-gas ratio, furnace pressure, and gas calorific value in the experimental furnace. Some of the factors governing correct port design, in particular the relative areas of air and gas ports, are investigated.

For additional annotations indexed in other sections, see:

3-141; **7**-184-185; **12**-81; **13**-22; **14**-118; **17**-38; **18**-88; **24**-134.

17 REFRACTORIES Furnace Materials

17-37. Heat Treatment of Refractory Materials. *Refractories Journal*, v. 23, March 1947, p. 99-105.
Investigation of several German plants for manufacture of basic bricks with particular reference to the design and operation of high-temperature kilns. (Reprinted from BIOS Final Report No. 831, Item No. 21 and 22.)

17-38. Cupola Refractories. Part II. Ray A. Witschey. *Foundry*, v. 75, May 1947, p. 94-95, 232, 234, 236, 238, 240.
Recommendations for maintenance of various sections of the cupola, mainly with design and replacement techniques.

17-39. New Refractory Gun Speeds Furnace Repairs. *Iron Age*, v. 159, May 8, 1947, p. 79.
Unit is equipped with a pressure hopper designed to hold 500 lb. of refractory weighing 140 lb. per cu. ft., has a discharge capacity of more than 100 lb. per min., and automatically wets the refractory shortly before the point of discharge.

17-40. Plastic Refractories. J. C. Hayman. *Iron and Steel*, v. 20, April 1947, p. 137-138.
Plastic refractories suffer from certain serious limitations, in particular the shrinkage tendency on drying and firing, and the lack of a substantial sinter as formed in situ.

17-41. Refractories From Ohio Dolomite. Harley C. Lee. *Ohio State University Engineering Experiment Station News*, v. 19, April 1947, p. 38-45.
Processing techniques used.

For additional annotations indexed in other sections, see:

6-84; **27**-97.

18 HEAT TREATMENT

18-84. Contribution a l'Etude des Aciers a Structures Intermédiares Obtenues par Trempe Etagee. (Contribution to the Study of Steels With Intermediate Structures Produced by Interrupted Quenching.) Georges Delbart and Ruben Potaszkin. *Revue de Métallurgie*, v. 43, March-April 1946, p. 84-94.
Effects of interrupted quenching and oil quenching on the structure and mechanical properties of a Cr-Mo steel containing 0.30% C, 2% Cr, and 0.5% Mo. Tabular data and diagrams are presented for four critical temperatures: 300, 400, 500, and 650° C.

18-85. High Frequency Induction Treatment and Its Application to Ferrous Metals. (Concluded.) R. J. Brown. *Sheet Metal Industries*, v. 24, April 1947, p. 793-796, 809.
Time of heating; quenching; steels suitable for high frequency treatment; properties of treated steels; other applications of high frequency heating.

18-86. Nitralloy Steels and the Nitriding Process. R. W. Allott. *British Steelmaker*, v. 13, April 1947, p. 180-186.
A brief history of the process; technique and advantages over previous methods of casehardening. (To be continued.)

18-87. Toolsteels. Part IV. L. Sanderson. *British Steelmaker*, v. 13, April 1947, p. 192-195.
Heat treatment of special alloy toolsteels. (To be continued.)

18-88. Recent Improvements in Cover Annealing. A. J. Fisher. *Iron and Steel Engineer*, v. 24, April 1947, p. 53-62; discussion, p. 63-64.
Annealing of sheets and tin plate originally was done by direct firing, without use of prepared atmospheres; however, with the advent of cold strip mills, radiant-tube furnaces were introduced. Repair costs were high, hence direct firing has been reintroduced, using specially designed burners and protective coatings developed for the inner covers of the furnaces. Details of the tin-plate coil bases used, the furnace instrumentation, and preparation of the furnace atmosphere.

(Turn to page 38)

Germans Devised Ways to Economize In Use of Alloys

Reported by Ray E. Cross

Chief Metallurgist, Michigan Light Alloys

Many interesting facts and sidelights on metallurgical developments in Germany were presented to the West Michigan Chapter ⊕ at its March 17th meeting in Grand Rapids by George Motock, metallurgical consultant. As a representative of this government, Mr. Motock inspected various plants and research laboratories in Germany, and gave his impressions of German practice in continuous casting, vacuum casting, metal diffusion, extruded bearings, the steel industry, lithium, beryllium and magnesium.

Considerable research had been done on recovery of manganese from low-grade ores, recovery of titanium and various other alloy metals from slags, nonaging steels, powder metallurgy, induction heating, degassing of iron, and improved bessemer steel (low in nitrogen) comparable to openhearth.

The Germans of necessity utilized plain carbon steels in many places where we in this country would have thought it necessary to use alloy steels. By selective treatment and slight variations in technique they were also able to secure properties comparable to alloy steels. The structures so fabricated were bolted or riveted rather than welded.

For severe corrosive conditions they substituted for stainless steels a low-carbon steel base coated with a high-chromium alloy by a diffusion process. The process utilized chromium chloride and hydrogen chloride atmosphere to secure a coating 0.004 to 0.006 in. thick in 4 to 5 hr. at 1850° F. Samples of this process were exhibited in which the base steel had been eaten away by acid leaving a shell of the high-chromium alloy.

Duplex melting utilizing basic melting and acid refining seems to have come to the front in Germany. Numerous plants blended metal from bessemer and openhearth, bessemer and electric, or openhearth and electric to obtain a better steel.

Vacuum melting came into its own in Germany, with furnaces ranging in size from 44 lb. to 8 tons. Alloys for high-temperature use such as in jet engines can be melted and much higher quality material produced free from oxides, nitrides, gas, and carbon.

Almost every executive in German industry, Mr. Motock observed, held a doctor's degree and was a technical graduate. The Germans were very efficient with their limited resources. We should not underrate their mentality.

Following Mr. Motock's excellent review, Mr. Walker of the Brown Instrument Co. presented a brief talk on electronics and vacuum tubes, and exhibited Walt Disney films on "Basic Electricity" and "Basic Electronics".

18-89. Controlled Atmospheres for Magnesium Alloy Heat Treatment. Frank Allen. *Light Metals,* v. 10, April 1947, p. 169-172.

The theory and practice of protective atmospheres and some shortcomings of the purely academic approach.

18-90. Planning Heat Treat Cycles to Avoid Production Delays. J. Edwin Burkhardt. *Materials & Methods,* v. 25, April 1947, p. 157.

Method of aging four alloys together, at 350° F. for 8 hr. or 340° F. for 10 hr., saves at least 40 hr. of furnace time each week, and eliminates the need for using other furnaces.

18-91. The Relationship of the Growth Exhibited on Nitriding to the Microstructure of the Nitrided Specimen. Part I. Lester F. Spencer. *Steel Processing,* v. 33, April 1947, p. 227-231, 239, 242, 245-246.

Possibility of minimizing growth by varying the heat treatment prior to the nitriding process. The final microstructures obtained with a variety of prior heat treatments; study of nitrided structure at high magnifications; characteristics of nitrided case.

18-92. Heat Treatment and Aging 61S Sheet. J. A. Nock, Jr. *Iron Age,* v. 159, April 24, 1947, p. 48-54.

Effects of solution heat treating temperatures, room-temperature aging, artificial-aging temperatures, interval of room-temperature aging prior to artificial aging, and reheating of heat treated material, on physical properties of this alloy. Corrosion resistance.

18-93. Phosphor Bronze Production Increased. Arthur Q. Smith. *Industrial Gas,* v. 25, April 1947, p. 12-13, 30.

Fabrication and finishing operations of Phosphor Bronze Smelting Co., Philadelphia, for producing rods, rounds, hexagons and squares; sheet and strip; and wire. Heat treating equipment.

18-94. Efficient Wire Rope Production. Gerald Eldridge Stedman. *Industrial Gas,* v. 25, April 1947, p. 16-17.

Technique of Union Wire Rope Corp., Kansas City, Mo. Equipment for patenting, cleaning, baking, galvanizing.

18-95. Heat Treating Fasteners by the Million. Herbert Chase. *Steel,* v. 120, May 5, 1947, p. 104-106, 148.

Integrated setup designed to heat treat, clean, and apply finish to small stamped parts in batches ranging from a few hundred up to hundreds of thousands.

18-96. Basic Requirements of Materials for Induction Hardening. Russell H. Lauderdale. *Product Engineering,* v. 18, May 1947, p. 110-115.

Key factors for obtaining best results from induction hardening including selection and processing of steels, power requirements, desirable initial microstructure, size and shape of parts, carbon content of steel, control of dimensional changes, and proper processing of parts.

18-97. Improvised Supercooling Unit. *Machinery,* v. 53, May 1947, p. 153.

Unit was constructed by cutting a 4-in. high section from the top of an empty 55-gal. oil drum. The bottom of this drum was lined with insulating refractory, and the openings between the insulating bricks were filled with powdered silocel. The remainder of the inside wall of the drum was also lined with insulating refractory brick.

18-98. Tooling Requirements for Induction Heating. Otto Weitmann. *Machinery,* v. 53, May 1947, p. 167-170.

Some installations engineered by Lepel High Frequency Laboratories.

18-99. Induction Hardening Steel Bars at J. & L. John F. Wilson. *Iron Age,* v. 159, May 15, 1947, p. 44-46.

Heat source, special bar handling equipment and processing steps.

For additional annotations indexed in other sections, see:
3-129-140-143; 6-82; 9-52; 14-137; 16-59; 19-144; 20-205.

19 WORKING—Rolling, Drawing, Forging

19-120. Découpage, Perçage, Formage, Emboutissage sur Coussins de Caoutchouc. (Cutting, Piercing, Forming, and Stamping Using Rubber Cushions.) *Revue de l'Aluminium,* v. 24, Jan. 1947, p. 29-35.

The use of rubber cushions between the work and the tool as an aid in operations on aluminum sheet. The techniques used for different situations; dimensional information given in tables.

19-121. Zinc-Alloy Press Tools. Part II. J. W. Sladden and H. S. Walker. *Aircraft Production,* v. 9, April 1947, p. 145-149.

Drop-hammer and stretching-press technique; preparation and use of blanking dies in K. M. alloy; some cost comparisons.

19-122. Forming Magnesium Sheet. L. M. Oldt. *Western Machinery and Steel World,* v. 38, April 1947, p. 82-86, 107.

Drawing, stamping, and pressing operations with brief references to stretch-forming and spinning. Equipment and lubricants.

19-123. A Process of Augmenting Cold Drawability of the Magnesium +1.5% Manganese Alloy. Louis A. Carapella and William E. Shaw. *Metals Technology,* v. 14, April 1947, T. P. 2149, 8 p.

Drawability at room temperature can be increased from 25% using current commercial techniques, to 40% by intermittent application of successively higher deformational loads. The proposed method is also recommended for improvement of deep drawing performance over a wide temperature range. Large increases in hardness have also resulted from this forming method.

19-124. Forming of Aluminum and Alloys by Drop Stamp. *Light Metal Age,* v. 5, April 1947, p. 6-9, 32.

Rope-operated and air-operated drop stamps plus tools utilized for both.

19-125. Panel Beating Aluminum. *Modern Metals,* v. 3, April 1947, p. 24-25.

Technique of panel beating; hollowing and raising methods; planishing; tools for panel beating; "split-and-weld" system of panel beating.

19-126. Magnesium Extrusions Offer Fabrication Economies. Herbert Chase. *Materials & Methods,* v. 25, April 1947, p. 96-99.

Typical examples of magnesium alloy extrusions including bars, tubes, and special shapes. Applications.

19-127. Proper Selection of Steel Simplifies Deep Drawing. G. B. Nisbet. *Materials & Methods,* v. 25, April 1947, p. 108-112.

Analyses of deep drawing steels; their physical properties; elimination of stretcher strains; die materials; die abrasion and lubrication.

19-128. The Rolling of Metals: Theory and Experiment. Part XIV. (Continued.) L. R. Underwood. *Sheet Metal Industries,* v. 24, April 1947, p. 753-757.

Methods used in practice for the calculation of rolling load and horsepower. (To be continued.)

19-129. Practical Problems of Light Presswork Production. (Continued.) J. A. Grainger. *Sheet Metal Industries,* v. 24, April 1947, p. 761-768.

Mechanical lubrication vs. manual lubrication; hand lubrication; hydraulic vs. mechanical presses for drawing; requirements in a mechanical press; hydraulic presses; operating features.

19-130. Metal Manipulation by Stretch Forming. (Continued.) R. Smith. *Sheet Metal Industries,* v. 24, April 1947, p. 787-792.

Pre-forming; types of blocks; tooling economies; dual-purpose blocks; a universal machine; block design.

19-131. The Heating and Rolling of Strip Steel. Paul Carnahan. *Iron and Steel Engineer,* v. 24, April 1947, p. 71-75; discussion, p. 75-76.

Principles of operation of the modern continuous wide strip mill.

19-132. The Corrugating of Sheet Metal. J. E. Kiefer. *Iron and Steel Engineer,* v. 24, April 1947, p. 95-101; discussion, p. 101.

The machinery used to make sheet having a variety of corrugation designs other than the conventional type.

19-133. Body Stampings Pour in a Steady Stream From Huge Presses at Kaiser-Frazer Corp. P. D. Aird. *Modern Industrial Press,* v. 9, April 1947, p. 13-14, 16, 18, 28.

Equipment and procedures employed.

19-134. Modernization at the Sheffield Forge and Rolling Mills Co., Ltd. *British Steelmaker,* v. 13, April 1947, p. 187-191.

New rod mill and its lubrication system.

19-135. Rolling Loads. Eustace C. Larke. *Metal Industry,* v. 70, April 4, 1947, p. 223-225.

Factors affecting the magnitude of rolling load. Effects of surface condition, of deforming tools, of initial thickness, of roll diameter, resistance to homogeneous deformation, and distribution of pressure on the roll face. (Paper presented before the Midland Metallurgical Societies.)

19-136. Blanking, Piercing and Forming. (Concluded.) J. W. Sladden and H. S. Walker. *Metal Industry,* v. 70, April 4, 1947, p. 227-228.

Development of zinc alloy tools for sheet-metal parts.

19-137. Rolling Loads. (Continued.) Eustace C. Larke. *Metal Industry,* v. 70, April 11, 1947, p. 243-245.

Diagrams show examples of distribution of pressure when compressing cylinders; effect of roll surface on rolling load and roll-face pressure; roll-face pressure distribution when rolling mild steel; increasing deforming load for decreasing initial thickness; variation of arc of contact with roll diameter; increasing resistance to deformation for increasing initial area of contact.

19-138. Washington Steel Starts Sendzimir Mill. *Iron Age,* v. 159, April 24, 1947, p. 63-64.

New mill proves capable of rolling stainless steel to extra thin gages and widths up to 36 in., holding finish and gage consistently throughout the coil. Production to be about 1500 tons of extra-light-gage stainless monthly.

19-139. Forming Magnesium Alloys. Part IX. Allen G. Gray. *Steel,* v. 120, April 28, 1947, p. 105-106, 138, 140, 145-146.

Drawing, hand and stretch forming, bending extrusions, spinning and forging techniques. (To be continued.)

19-140. New Company Makes Stainless Steel Sheets and Strips. *Steel,* v. 120, April 28, 1947, p. 118-120, 123.

How precision cold rolling equipment, annealing and pickling, slitting and shearing facilities convert 1500 to 1700 tons per month of hot rolled stainless into sheets and strip.

19-141. Forging Practice. Anderson Ashburn. *American Machinist,* v. 91, May 8, 1947, p. 117-132.

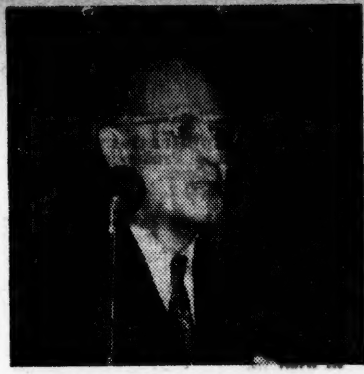
What constitutes current practice

(Turn to page 40)

Metallurgy Supplies Gasoline for Battle of Britain

Reported by H. L. Millar
Assistant Metallurgist, Plomb Tool Co.

An intensely interesting story of the successful application of metallurgy in winning the Battle of Britain was related by Harry K. Ihrig of Globe Steel Tubes Co., Milwaukee, before the Los Angeles Chapter ⊕. Dr. Ihrig spoke on "The Corrosion and Application of Alloy Steels at High Temperature Under Alternating Oxidizing and Carburizing Conditions".



Harry K. Ihrig

As director of laboratories for his company, Dr. Ihrig has been closely associated with new developments in the petroleum industry during the last few years, chief among which are the production of toluene, butadiene and high-octane gasoline. Relating how the lack of suitable metals often delays development of important projects, the speaker gave a vivid description of preliminary experiments on metals under alternating oxidizing and carburizing conditions such as encountered in the dehydrogenation of butane to butylene.

The catalytic reaction in this process at high temperatures and its reversal three or four times an hour for the regeneration of the catalyst made it difficult to predict the behavior of the metal in the reactor tubes. A pilot plant was therefore constructed in which tubes of various compositions were installed. At the conclusion of experimental operation of this pilot plant for 1000 hr., it was found that the iron oxide contamination of the catalyst occurred at considerably lower temperatures after the inside surfaces of the tubes had been carburized during the alternate cycle.

Such harmful contamination, it was found, was best resisted by the chromium heat resisting steels. Those reactor tubes which gave most efficient service, according to Dr. Ihrig, were made from Type 446 stainless steel (27% Cr) with 0.1% nitrogen.

It was learned also that sulphur pick-up by the metal in the tubes tended to increase their service life by counteracting the injurious effect of carburizing. Even though this effect was not fully understood, sulphur was added to the feed stock during the process of dehydrogenation.

Depreciation of the mechanical properties of the metal by continuous use of the unit at elevated temperatures was another problem which confronted the scientists. It was solved satisfactorily, however, by an annealing treatment at 1500° F. By an ingenious provision of the process, the tubes, which were charged with the catalytic mixture of chromium and vanadium oxides, could be annealed without removal from the installation.

Patterned after the pilot plant and containing all of the improvements devised from its operation, a large production plant was built in England to supply high-octane gasoline for allied fighter and bomber planes operating over Europe. At the conclusion of the war, after 2½ years of continuous operation, the reactor tubes were found to be in excellent condition.

Commenting on the successful application of the ingenuity of our scientists to devise materials for war, Dr. Ihrig concluded with the belief that the same forces could be applied just as successfully for industry in peace.

and how it varies for the various forgable materials. Testing and inspection.

19-142. Allowances for 90° Bends in Sheet Steel. Part I and II. Alf J. Abrahamsen. *American Machinist,* v. 91, May 8, 1947, p. 167, 169.
Square and reverse bends. Fractions and decimal equivalents and weights of sheet steel per sq.ft. in gage numbers 10 to 24 inclusive.

19-143. 80-In. Cold Reduction Reversing Strip Mill at Messrs. John Summers and Sons, Ltd., Shotton, Chester. *Journal of the Iron and Steel Institute,* v. 155, March 1947, p. 442-444.
Layout of new mill and how it fits into general plant design.

19-144. Cold Working and Recrystallization of 70-30 Cartridge Brass. Charles A. Nagler and Ralph L. Dowdell. *Metallurgia,* v. 35, April 1947, p. 285-289.
Details of an extensive experimental program on the relationships between cold reduction, annealing temperature, and hardness. Results tabulated, charted, and illustrated by an excellent series of photomicrographs.

19-145. Fabricating Stainless Steel Equipment. H. Seymour. *Petroleum,* v. 10, April 1947, p. 85-86.
Petroleum refinery and laboratory equipment fabrication techniques include shearing and slitting, blanking and punching, drawing, spinning, surface finishing, and cleaning of drawn parts.

19-146. Rolling Loads. (Concluded.) Eustace C. Larke. *Metal Industry,* v. 70, April 18, 1947, p. 263-265.
Factors affecting their magnitude: distribution of roll-face pressure; distortion of roll-contact surface; effect of coiler and decoiler tension.

19-147. Substantial Processing Economies With Nonferrous Forgings. B. B. Caddle. *Production Engineering & Management,* v. 19, May 1947, p. 51-56.
Treatise on the manufacture and use of nonferrous forgings; their cost-saving potentialities.

19-148. Functional Press Layout Provides Direct Material Flow. *Production Engineering & Management,* v. 19, May 1947, p. 63-64.
New body presses recently installed at Kaiser-Frazer Willow Run plant produce panels for more than 1500 bodies daily.

19-149. Cutting Material and Production Costs With Shot-Peening. R. A. La Combe. *Production Engineering & Management,* v. 19, May 1947, p. 75-79.
Recent developments in shot-peening methods and equipment which have greatly extended the number of applications on which process may be used. New safety factors and production economies reported by users.

19-150. Hydraulic Presses Establish Production Gain. *Production Engineering & Management,* v. 19, May 1947, p. 80-81.
How constant ram velocity and accurate pressure control which are inherent in hydraulic presses have enabled Servel, Inc., to eliminate one operation formerly required for the deep drawing of embossed refrigerator doors.

19-151. Pacific Northwest Plant Rolls Merchant Bars. Gerald Eldridge Stedman. *Steel,* v. 120, May 12, 1947, p. 128-130, 132.
Oregon steelmaker employs double slag in refining electric-furnace heats. Eight pouring pits provide for 250 molds. Spreader bar facilitates stripping from four to six ingots from their molds simultaneously.

For additional annotations indexed in other sections, see:
3-118-133; **7**-183; **12**-80; **18**-93-94; **21**-46-47-49; **23**-131-150-156-158; **24**-124-126; **27**-90.

20 MACHINING AND MACHINE TOOLS

20-202. New Applications of Roto-Shaving in Mass Production Increase Output and Cut Costs. *Automotive and Aviation Industries,* v. 96, April 15, 1947, p. 28-29, 68.
Three Red Ring Roto-Shavers for finishing the back face of rear-axle ring gears, the flange diameter and face of differential to required dimensional tolerances, axial alignment, and finish in one setting, and to finish simultaneously the outside diameter of both hubs as well as the shoulder. Diameters are readily held to a tolerance of 0.001 in.

20-203. How to Set Up Carbide Milling Jobs. H. A. Frommelt. *American Machinist,* v. 91, April 24, 1947, p. 77-100.
Ten steps suggested are: Identify and classify material; select surface speed; select cutter type and diameter; determine metal-removal rate of the workpiece; correlate metal-removal rate with horsepower available in the milling machine designated for the job; establish feed rate from the foregoing data; check tooth load; specify milling method (conventional or climb), holding method or fixture, chip disposal; establish cutter care and grinding procedure; and check surface and tolerance specifications and their influence on metal-removal rate.

20-204. Practical Ideas. *American Machinist,* v. 91, April 24, 1947, p. 111-116.
Direct-reading indicator measures concave or convex radii. Old saws make crush-form masters. Spring-shank chuck gives uniform feed. Hex-body collet chuck. Rubber-washer cutter. Deep facer dresses valve seats in place. Hints on small tools. Air cylinders improve milling machine fixture. Guide puts accuracy into plastic bushing production. Adjustable-centers roll drive maintains constant surface feed.

20-205. Screw Holes for Broach Inserts and Holders. *American Machinist,* v. 91, April 24, 1947, p. 139.
Standard for dimensioning screw holes and washers for broach inserts and holders. Permits the best heat treatment without the restriction of controlling location of holes because of growth.

20-206. The Devlieg Jigmil. *Automobile Engineer,* v. 37, March 1947, p. 98-100.
New machine for high precision boring and milling.

20-207. The Production of Gear Hobbing Machines. (Continued.) *Machinery (London),* v. 70, March 20, 1947, p. 281-286.
The work done in the machine shops and light fitting and assembly shops.

20-208. The Mechanism of Tool Vibration in the Cutting of Steel. Part II. *Machinery (London),* v. 70, March 20, 1947, p. 291-293; discussion, p. 294-295.
Relation between amplitude, cutting speed, tool frequency, and depth of cut; cutting interference.

20-209. Spline-Hobbing Fixture With Positive Angular Location. *Machinery (London),* v. 70, March 20, 1947, p. 295.
Simple fixture designed for holding shaft and pinion while hobbing the six splines on the shaft portion. The angular position of these splines in relation to the gear teeth is explained.

20-210. Fellows Gear-Shaper Setup for Cutting Ratchet Teeth. *Machinery (London),* v. 70, March 27, 1947, p. 313.
Component comprises a brass tube on to which is soldered a brass hub in the form of a machined stamping. The 14 ratchet teeth are cut on the hub after assembly, the operation being performed on a Fellows Type 7, high-speed gear shaper using a special work-holding fixture.

20-211. Large Capacity Hydroptic Jig Boring and Milling Machine. *Machinery (London),* v. 70, March 27, 1947, p. 322-324.
Various new features in large machine include measuring system for determining table and saddle settings, single-lever control of elevation and clamping, and a special table size and action.

20-212. The Broachability of Materials. Harry Gotberg. *Materials & Methods,* v. 25, April 1947, p. 103-107.
Effect of materials on broaching and broachability of steels in general; stainless steels; cast and malleable iron; brasses and bronzes; aluminum and magnesium; plastics.

20-213. Thrust Loads in Drilling. *Materials & Methods,* v. 25, April 1947, p. 147.
Tables for cast iron, machine steel, cast steel, and carbon steel.

20-214. A Handy Milling Fixture. Robert Mawson. *Materials & Methods,* v. 25, April 1947, p. 157.
Milling fixture simplifies the machining of a large quantity of small brass connectors.

20-215. High Porosity Grinding Wheels. G. B. Lurye. *Engineers' Digest (American Edition),* v. 4, April 1947, p. 191.
The various factors involved in the process of grinding, and steps recommended for improved results. (Abstracted from *Automobilnaya Promyshlennost,* Russia, no. 3, 1946, p. 12-15.)

20-216. Profiling Impeller Vanes. (Continued.) *Aircraft Production,* v. 9, April 1947, p. 153-156.
Cincinnati hydraulic profile-copying machine used in machining for gas turbines.

20-217. Largest Machine Tool Made on Coast. *Western Machinery and Steel World,* v. 38, April 1947, p. 94-95.
New lathe is manufactured in two sizes, a 20-in. lathe with 24 speeds and a 25-in. lathe with 16 speeds. Beds are of massive rigidity to give the fullest support to the rest of the lathe assembly while maintaining perfect alignment under any strain and stress of heavy-duty cutting.

20-218. Turning Noncircular Shapes. R. H. P. Nott. *Machinery (London),* v. 70, April 3, 1947, p. 345-347.
Complex machine designs which enable noncircular shapes to be produced by turning. The top rake of the tool relative to the work is maintained constant.

20-219. Internal-Threading Toolpost. *Engineering,* v. 163, April 4, 1947, p. 264.
Device for cutting internal threads with a single-point lathe tool characterized by a device which automatically withdraws the tool from the cutting position as soon as the desired number of threads has been cut.

20-220. 4-In. Hydraulic Grinding Machine. *Engineering,* v. 163, April 11, 1947, p. 283-284.
Details of the construction of a machine made by a British firm.

20-221. How to Use Carbide Cutters for Milling. Part X. H. A. Frommelt. *Iron Age,* v. 159, April 24, 1947, p. 58-62.
Factors in establishing good practice for milling operations, including attention to economical cutter life, acceptable surface finish, and adherence to specified dimensional accuracy, as well as the selection of the proper type of machine, holding and handling of the workpiece and grinding the cutter.

20-222. One Way to Produce a Cam. Robert Mawson. *Steel,* v. 120, April 28, 1947, p. 108, 136.
Methods used at John O. Pelchat Sawing Service, Providence, R. I. Illustrates one type of cam.

20-223. Production With Light Machine Tools. Part I. John E. Hyler. *Modern Machine Shop,* v. 19, May 1947, p. 124-130, 132.
Special tools and attachments indi-
(Turn to page 42)

Continuous Casting Promotes Use of Refractory Bronze

Reported by Ralph W. Bailey

American Smelting and Refining Co.

An eagerly awaited talk on the continuous casting process as practiced by the American Smelting and Refining Co., Barber, N. J., was given by John L. Kimberley, an engineer of the sales department, before the New Haven Chapter's March meeting.

The continuous casting process is being used in commercial production of copper billets for piercing, and of bronze (copper-tin-lead-zinc) rod, tubing and bars. These alloys are produced in forms "to-be-wrought" and as stock to be machined and used as cast for bearings, bushings, gears, and similar products.

Briefly, the process consists in the continuous withdrawal of metal from a casting crucible, through a water-jacketed mold or die suitably mounted in the bottom of the crucible. Molten metal, which is supplied to the casting furnace from an auxiliary melting furnace, is maintained at a proper casting temperature and level. Solidification occurs in the mold, and driven rolls mounted below withdraw the solidified shape at a controlled speed. A flying saw is used to cut the cast product in uniform lengths as required.

Characteristics of the products include unusually fine and uniform dispersion of lead and other secondary constituents, unusual soundness and density, close control of cast dimensions (the concentricity of tubing is noteworthy) and good physical properties. Mr. Kimberley cited tentative bronze alloy specifications as: copper, 65% min.; tin, 13% max.; lead, 25% max.; zinc, 10% max.

Consistently high yield of a finished product of excellent quality has been reported by fabricators of the so-called "refractory" bronze alloys. Processing of these materials is simplified, and can be standardized in schedules comparable to those used for more workable alloys.

"Casting" alloys are produced in 10-ft. (or longer) lengths of rod and tubing, adaptable for high-speed automatic machining of bearings, bushings, and gear blanks to be used "as cast".

Continuous casting, the speaker predicted, because of the inherently better quality of product obtained, and greater simplicity and economy in fabrication either by cold working or machining, will lead to a substantial increase in the commercial use of refractory bronze alloys.

Design and Development Of Naval Ordnance Traced

Reported by W. S. Lienhardt

General Superintendent
Metal & Thermit Corp.

Design and development of many types of naval ordnance since before the start of World War II were traced by P. H. Girouard before the Calumet Chapter on April 8. Mr. Girouard, who has been with the Bureau of Ordnance of the Navy Department since 1917, and has been chief engineer since 1943, spoke on "Naval Ordnance".

He also outlined the important part many of the plants in the Calumet area played in the development and production program. At the end of the talk several movies were shown demonstrating naval ordnance in action and the atom bomb tests at Bikini.

Tech Societies Form Council

The Technical Societies Council of New York, an outgrowth of a "War Production Committee" made up of engineers and technicians, has now been incorporated, and its first *Bulletin* issued. The council is made up of 14 engineering, scientific and technical societies, including the New York Chapter of the American Society for Metals, represented on the board of directors of the council by E. M. Sherwood.

Toolsteel Committee Completes Work For 1947 Handbook

Twelve of the nation's technical leaders in the toolsteel industry, members of the Toolsteel Committee of the American Society for Metals, have completed their correlation of data in connection with the society's 1947 Metals Handbook. This year's Handbook, soon to be published, will be the first since the 1939 edition.

The Handbook's Tool Steel Committee consists of S. C. Spalding, chairman, American Brass Co.; W. L. Badger, General Electric Co.; A. D. Beeken, Vulcan Crucible Steel Co.; J. P. Bindyke, Heppenstall Co.; G. E. Brumbach, Carpenter Steel Co.; W. R. Frazer, Union Twist Drill Co.; W. H. Macmillan, Remington Arms Co., Inc.; W. E. Mahin, Armour Research Foundation; J. H. McCadie, National Twist Drill and Tool Co.; J. E. McCambridge, U. S. Navy Yard; H. E. Replogle, Universal-Cyclops Steel Corp.; and G. A. Roberts, Vanadium-Alloys Steel Co.

Seventeen articles have been prepared by the committee for inclusion in the Handbook. In order to correlate the large amount of information available and to reduce the number of steels to manageable proportions, a condensed tabulation of toolsteels was prepared according to approximately 50 principal types. With both producers and users of toolsteels represented in the manuscript, the final summary of information can be accepted as an authoritative and acceptable compilation.

cate the possibilities of meeting production schedules with a minimum investment in equipment.

20-224. Finishing Fuel Injection Nozzle. Paul Grobey. *Modern Machine Shop,* v. 19, May 1947, p. 148-150, 152, 154.

A new method of finishing small injection nozzles on a production basis to extremely close limits of accuracy.

20-225. Ideas From Readers. *Modern Machine Shop,* v. 19, May 1947, p. 188-190, 192, 194, 196, 198, 200, 202.

Removing broken tools by blasting. Increasing production by cooperation. Safety suggestion. Extension cord brackets keep aisles clear. Electric limit switch saves cutters. Gages insure accurately ground tools.

20-226. Basic Components Underlie Machine Electrification Program. *Electrical Manufacturing,* v. 39, May 1947, p. 78-82, 158-162, 164, 166.

Monarch Machine Tool Co.'s latest types of machine tools, emphasizing electrical features.

20-227. Lear Solves Short Run Problem for Electro-Mechanical Accessories. Joseph Geschelin. *Automotive and Aviation Industries,* v. 96, May 1, 1947, p. 40-41, 82, 84.

How combinations of standard units, changes in gear ratio, variations in motor size, and the addition of special accessories make possible an endless chain of control devices adaptable to applications of amazing variety.

20-228. How to Use Carbide Cutters for Milling. Part XI. H. A. Frommelt. *Iron Age,* v. 159, May 8, 1947, p. 75-79.

Tool grinding and reconditioning; selecting a solvent; blade setting. Simple and effective method whereby tools can be ground to the desired angles without the use of costly equipment or highly skilled operations.

20-229. Shaving Applied to Marine Gears. *Iron Age,* v. 159, May 8, 1947, p. 86.

Westinghouse engineers obtain full face contact without recourse to lapping or other finishing methods. Hobbing feeds and speeds have been increased as much as 50% without sacrifice of accuracy but with a somewhat rougher surface that can be corrected by shaving. Resulting shaved-tooth surface has about twice as fine a finish as the best hobbed surface even at slow hobbing speeds.

20-230. Shop Shots. *American Machinist,* v. 91, May 8, 1947, p. 106-107.

How triple-purpose gage checks armature-shaft diameter and width and position of the Woodruff keyway with relation to shaft end and shaft axis; how spring-eyes are machine formed; cams level shop load; projections locate and hold.

20-231. Magazine Loading Speeds Second-Operation Work. W. L. Woodcock. *American Machinist,* v. 91, May 8, 1947, p. 108-110.

Magazine loader for second-operation work on B. & S. automatics built up of sheet metal and a metal block. Two runners on the bottom of the tray allow easy rolling of the gravity-fed pieces. Operating sequence and machine modifications.

20-232. Modern Tooling Steps up Buick Quality. Rupert Le Grand. *American Machinist,* v. 91, May 8, 1947, p. 114-116.

Details of new setups, placing emphasis on fixtures that can be loaded and unloaded easily in the retooling done for two parts, the oil-pump body and the exhaust-manifold valve body.

20-233. How to Specify Machine Tools for Carbides. Part I. H. A. Frommelt. *American Machinist,* v. 91, May 8, 1947, p. 134-137.

Various applications of carbide milling cutters, their increased efficiencies and their relation to the problem of machine-tool specifications and purchase.

20-234. Hydraulics Modernizes an Old Planer. L. C. Beatty. *American Machinist,* v. 91, May 8, 1947, p. 141.

How greater production is possible by cutting reversing and return-stroke time, even without large increases in cutting speeds.

20-235. Practical Ideas. *American Machinist,* v. 91, May 8, 1947, p. 143-148.

Fundamental analysis gives four methods for finding groove radii. Wedge-base V-block levels work easily. Auxiliary bar adjusts turret-boring tool. Drill press speeds nut removal. Adjustable-length gage has many uses. Dust collector for metallizing operations. Supported bar bores small deep holes. Spindle-reversal doubles production. Parallel locating blocks aid rotary table setups. Lathe carriage becomes hand shaper. Cam lock grinding dog.

20-236. Standard Keyway Broaches. *American Machinist,* v. 91, May 8, 1947, p. 171.

Standard dimensions for broaches to cut standard keyways.

20-237. Overhaul of Underground Rolling Stock. *Machinery (London),* v. 70, April 17, 1947, p. 393-398.

Typical machine-shop operations at the Acton Works of the London Passenger Transport Board.

20-238. The Hobbing Process for Mold Production. *Machinery (London),* v. 70, April 17, 1947, p. 402-404.

Process consists of forcing a hardened steel master of extreme density into a soft steel blank, the external dimensions of which are subsequently machined to size. Typical press for the production of multiple-impression molds.

20-239. Diesel Engine Production. *Machinery (London),* v. 70, April 24, 1947, p. 421-427.

Machining operations on various components.

20-240. Calculations for the Manufacture of Milling Cutters. K. G. Molnar. *Machinery (London),* v. 70, April 24, 1947, p. 428-431.

The basic principles, formulas, and calculations essential for correct setup.

20-241. An Improved Method of Securing Ejectors in Die-Casting Dies. H. K. Barton. *Machinery (London),* v. 70, April 24, 1947, p. 435-436.

New means of securing ejector rods entails the use of a specially designed circular clip, which is located in a narrow groove at a short distance from the rear end of the ejector. Application of such a clip to an ejector formed from a straight length of stock rod.

20-242. Operation of an Engine Lathe. *Machine and Tool Blue Book,* v. 43, May 1947, p. 137-140, 142-145.

Parts of a lathe that hold the tool and control its movement, or rate of feed.

20-243. Broaching Helical Splines in Blind Holes. C. W. Hinman. *Machine and Tool Blue Book,* v. 43, May 1947, p. 177-178, 180, 182, 184, 186.

How to broach 18 helical splines without the broaching cutter passing through the work. A few fundamentals of broaching.

20-244. Modern Centerless Grinding Practice. Part IV. D. E. Lower. *Machine and Tool Blue Book,* v. 43, May 1947, p. 231-238, 240, 242.

The various faults of surface quality, shape and dimensions that are likely to show up in centerless grinding by both the throughfeed and infeed methods. Causes that may be behind each fault.

20-245. Multiple-Spindle Automatics Speedup Dodge Piston Production. Charles H. Wick. *Machinery,* v. 53, May 1947, p. 154-160.

Unusual tooling on multiple-spindle, automatic chucking machines, and drilling and boring machines used in rapidly finishing aluminum alloy pistons.

20-246. Accurate Holes With 0.6 Micro-Inch Finish Ground in One Setup. Charles H. Wick. *Machinery,* v. 53, May 1947, p. 162-166.

Methods employed and equipment required in grinding holes to within ten-millionths inch for both roundness and straightness, and to finishes of less than 1 micro-inch root-mean-square.

20-247. Precision Boring of Cylinder Blocks on an Automatic Transfer Machine. *Machinery,* v. 53, May 1947, p. 171-173.

Machine semifinishes and finish-bores the camshaft and crankshaft bearing diameters, finish-straddle-mills the center main bearing, and finishes the V-shaped oil and cork grooves. The cycle is entirely automatic.

20-248. Tool Engineering Ideas. *Machinery,* v. 53, May 1947, p. 181-183.

Automatic burring of grooved and drilled cylindrical parts. High-production die for forming fine wires into ring-shaped parts. Contour-turning a bronze engine part by the use of a master form.

20-249. Machinery's Data Sheets 585 and 586. *Machinery,* v. 53, May 1947, p. 233.

Tables for use in checking internal gear sizes by measurement between wires.

20-250. Transfer Type Machine Trebles Production Rate. J. J. Smiley. *Production Engineering & Management,* v. 19, May 1947, p. 61-62.

Transfer type line-production machine has made obsolete 11 machine setups formerly required for the precision processing of differential carrier castings. Production has increased to 300 units per shift as compared to 94 per shift which were obtained on the 11 separate setups.

20-251. Carbides on Railroad Jobs. Part II. Carroll Edgar. *Railway Mechanical Engineer,* v. 121, May 1947, p. 242-245.

Applications of carbide tools in the railroad machine shop.

20-252. X-Ray Diffraction as a Gage for Measuring Cold Work Produced in Milling. F. Zankl, A. G. Barkow, and A. O. Schmidt. *Transactions of the American Society of Mechanical Engineers,* v. 69, May 1947, p. 307-317; discussion, p. 317-318.

An X-ray diffraction analysis established the fact that the cold work produced in the workpiece was effected by the radial-rake angle of the milling cutter. A milling cutter with a negative radial-rake angle required more power than a cutter with a positive radial-rake angle. Study also revealed that the negative radial-rake angle cutter produced a more intense and deeper cold work in the workpiece, both in the case of two magnesium alloys and in S.A.E. 1020 steel.

20-253. Surface Finish of Steel in Face Milling. A. O. Schmidt. *Transactions of the American Society of Mechanical Engineers,* v. 69, May 1947, p. 325-328; discussion, p. 328-329.

Tests show that quality of surface finish in face milling is determined less by the radial-rake angle than by the cutting speed and feed per tooth; at the same cutting speed and feed, the surface finish, as measured by a profilometer, is approximately the same for both negative and positive radial-rake angles; the higher the cutting speed and the finer the feed, the better the surface finish. However, at too fine a feed and too high a cutting speed the cutter will wear rapidly; heavy feeds and slow cutting speeds will result in poorer surface finish.

20-254. How to Use Carbide Cutters for Milling. Part XII. H. A. Frommelt. *Iron Age,* v. 159, May 15, 1947, p. 62-65.

Necessity for complete educational program starting with top management and continuing through the ranks to the actual operators, including both classroom theory and practical demonstration on work regularly handled in production, when convert-

(Turn to page 44)

Broader Future for Arc Furnace Seen

Reported by A. W. Crossley
Trans-Canada Air Lines

"Steelmaking in the Modern Arc Furnace" was the title of an interesting talk presented by William McDiarmid of the Manitoba Rolling Mill Co., Ltd., before the April meeting of the Manitoba Chapter ⊕.

A brief historical outline of the development of the arc furnace was given, beginning in Europe late in the 18th Century. Rapid advances in both number and size of installations took place during World War I. Steady progress has been made since, as further improvements have opened up new fields of use for this method of steelmaking.

The speaker described in detail the acid and basic electric furnace processes and the types of steel produced by each. He explained how the electric arc method of steelmaking gives a closer control over the quality of the product and a cleaner, purer steel. Also described were the construction of the furnace, methods of charging, the raw materials used, and the electrical equipment.

It is difficult to cover briefly all electric furnace practices, Mr. McDiarmid pointed out, because of the variety of products, ranging from stainless and toolsteels to all other alloy grades and plain carbon steels. All, however, are governed by such factors as slags, raw materials available, characteristics of charge, preference of various operators and the final product required.

No other steelmaking process is so flexible, and when the gas-slag-metal reactions in the electric arc furnace become as well known as they are in openhearth practice, then new methods may become evident that are not even suspected today.

Electric Furnace President

K. U. Wirtz, formerly executive vice-president of the Electric Furnace Co., Salem, Ohio, has been elected president of the company, filling the vacancy created by the recent death of R. F. Benzinger. Mr. Wirtz, a graduate of Case School of Applied Science, joined the Electric Furnace Co. organization in 1927 as an erection engineer. He has served in various capacities including that of chief estimator, sales engineer and assistant secretary before being advanced to the office of executive vice-president of the company in 1946.

K. U. Wirtz

Possibilities of Magnesium For Structural Uses Shown

Reported by J. W. Sweet
Chief Metallurgist, Boeing Aircraft Co.

The possibilities of "Designing With Magnesium" were presented at the March meeting of the Puget Sound Chapter ⊕. John C. McDonald, assistant technical director, magnesium division, Dow Chemical Co., gave an illustrated presentation dealing with three main topics:

1. Basic factors governing the use and choice of magnesium.
2. Structural design; the possibility of using the lightness of magnesium to achieve simplification of structure with resultant increased serviceability and lowered cost.
3. Detail design; fatigue and effect of stress raisers.

Mr. McDonald left with the members a clear understanding of the possibilities of magnesium for structural uses.

Taylor-Hall Licenses DoAll Co.

The Taylor-Hall Welding Corp., subsidiary of the Federal Machine and Welder Co. of Warren, Ohio, has entered into an agreement with the DoAll Co. of Des Plaines, Ill., which gives the latter company the exclusive right to sell Taylor-Hall Welding Corp. products in the export market. The DoAll Co. maintains 56 sales offices in principal cities throughout the world.

ing from conventional tooling to carbides. (To be continued.)

20-255. Automatic Size Control of Automotive Cylinder Bores. *Iron Age,* v. 159, May 15, 1947, p. 66.

A honing machine equipped with a Micromatic Hydro-size six-spline head and tools and fixtures to eliminate or materially reduce selective fitting of pistons in automotive cylinder bores. In a honing cycle of 30 sec., equipment removes an average of 0.004 in. of stock from each of the six bores, corrects out-of-roundness and taper, and holds bore-to-bore size to not over a 0.0005-in. variation.

For additional annotations indexed in other sections, see:
3-143; **5**-33; **7**-172; **23**-138-147-152-154; **24**-132; **27**-90.

21 LUBRICATION and Friction; Bearings

21-40. Latest Developments in Engine Bearings. Part II. P. M. Heldt. *Automotive and Aviation Industries,* v. 96, April 1, 1947, p. 34-37, 62.

Production, inspection, and test methods for aircraft-engine bearings.

21-41. An Electron Microscope Study of Lubricating Greases. B. B. Farrington and D. H. Birdsall. *Institute Spokesman,* v. 11, April 1947, p. 4-10.

Micrographs presented show, in considerable detail, the fibrous structure of various types of metal-soap greases. This type of structure is verified for all types so far examined (with the possible exception of the aluminum-base greases).

21-42. Lubricating Properties of Molecular Layers of Stearic Acid and Calcium Stearate on Metal Surfaces. J. N. Gregory and J. A. Spink. *Nature,* v. 159, March 22, 1947, p. 403.

Friction-temperature measurements of layers of calcium stearate and stearic acid on various metals. Results discussed from a theoretical point of view.

21-43. Centralized Lubrication in Industry. E. I. Pfaff. *Iron and Steel Engineer,* v. 24, April 1947, p. 77-81; discussion, p. 81-84.

Use of systems for miscellaneous heavy steel-mill equipment.

21-44. Possible Causes of Failure of High Speed Engine Bearings. B. C. Kroon. *Engineers' Digest (American Edition),* v. 4, April 1947, p. 192-193.

Bearing failure in high-speed diesels. A mathematical analysis of the relationship between the specific bearing pressure, engine speed, oil pressure differential in the bearing, and oil viscosity. Conclusions resulting from an investigation of the bearings of two four-stroke diesels operating at 2000 and 1200 r.p.m., respectively, and one two-stroke diesel running at 2000 r.p.m. (Abstracted from *De Ingenieur,* v. 59, no. 3, Jan. 17, 1947, p. 1-8.)

21-45. Lubrication of Bearings. *Product Engineering,* v. 18, May 1947, p. 125-127.

The dependence of pressure on viscosity, adsorbed heat, and the effect of additives in lubricating oil. (From "Bearing Friction and Border Surface Phenomena" by S. Kieskalt. *V.D.I. Zeitschrift,* May 29, 1943, p. 321.)

21-46. Lubrication in Iron and Steel Works Engineering. H. J. Knight. *Journal of the Iron and Steel Institute,* v. 155, March 1947, p. 423-430; discussion, p. 431-441.

American practice in lubrication of blast furnaces, gas regulators, electrical equipment, gears and pinions of rolling mills, backup roll neck. Types of oils used and amount of oil.

21-47. Colloidal Graphite in the Metal Industry. *Metallurgia,* v. 35, April 1947, p. 301-302.

Application of colloidal graphite facilitates such operations as die casting, extrusion, stamping, wire drawing; its use reduces maintenance costs, especially when applied to parts operating at elevated temperatures.

21-48. Distribution of Bearing Reactions on a Rotating Shaft Supported on Multiple Journal Bearings. S. S. Manson and W. C. Morgan. *National Advisory Committee for Aeronautics Technical Note No. 1280,* May 1947, 16 p.

An analytical treatment of the problem which differs from others in common use in that account is taken of hydrodynamic effect of oil film between journals and bearings.

21-49. Smallest Bearings Are Cold Pressed. *Production Engineering & Management,* v. 19, May 1947, p. 92.

Tiny balls for fountain pens, untouched by hands during manufacture, are inspected, gaged and packaged under rigidly controlled temperature conditions. Special process gives the balls a satin-like finish to give lubricants and inks a greater surface cohesion. This surface consists of minute scratches on the balls.

For additional annotations indexed in other sections, see:
3-130; **5**-32; **19**-122-127-129-134; **24**-138.

22 WELDING Flame Cutting; Riveting

22-227. Some Fundamental Principles for the Resistance Welding of Sheet Metal. (Continued.) H. E. Dixon. *Sheet Metal Industries,* v. 24, April 1947, p. 813-820.

Material characteristics; resistance welding of low carbon steels; a.c. spot welding of thin sheets; condenser discharge spot welding of thin low-carbon sheet; and spot welding of thick low-carbon steel sheets. (To be continued.)

22-228. Industrial Practice for Spot Welding Light Alloys. *Sheet Metal Industries,* v. 24, April 1947, p. 824-828, 830.

Paper prepared by the L.R. 4 Committee on spot welding procedure for light alloys as a basis for revision of B.W.R.A. Memorandum T.8. Machines and settings; machine maintenance; surface preparation; pickling solutions for aluminum; measurement of contact resistance; electrodes; method of assembly; inspection and control; solutions and pastes for surface preparation.

22-229. Inert-Gas Shielded-Arc Welding for Difficult-to-Weld Materials. H. R. Clauser. *Materials & Methods,* v. 25, April 1947, p. 86-90.

Variety of materials that can be welded; process characteristics; costs; design considerations; welding procedure and technique.

22-230. Metallic Joining of Light Alloys. (Continued.) *Light Metals,* v. 10, April 1947, p. 203-209.

American investigations on soft-soldering practices for aluminum. The possibilities of supersonic vibration as an aid to "tinning".

22-231. Automatic Welding in Steel Plant Maintenance. H. E. Holman. *Iron and Steel Engineer,* v. 24, April 1947, p. 89-93; discussion, p. 93-94.

Use in reclaiming rotating parts.

22-232. Oxy-Acetylene Cutting in Sheet Metal Work. Part II. R. F. Helmkamp. *Sheet Metal Worker,* v. 38, April 1947, p. 57-60, 102-103.

Possibilities and limitations of the process in the shop.

22-233. Tough Alloys Cut Like Cheese. Fred P. Peters. *Scientific American,* v. 176, April 1947, p. 149-152.

Processes developed by Linde Air Products, Air Reduction, and Arcos Corp.

22-234. "Musts" in Silver Brazing Stainless. A. W. Swift. *Steel,* v. 120, April 28, 1947, p. 98-99, 132.

Fittings and connections are easily brazed on stainless steel if controls are exercised in cleaning joint area, fluxing, heating, and tinning. Main difficulty lies in handling chromium oxide which forms rapidly on surface of steel. Analyzes and disposes of problems encountered on several specific production jobs.

22-235. Salvaging Iron Castings With Machinable Arc Welds. David W. DeArmand and Samuel Epstein. *Foundry,* v. 75, May 1947, p. 146, 148, 254.

Technique using Ni-Rod, a development of International Nickel Co.

22-236. Effects of Flux in Welding Stainless Steel. G. Richardson. *Iron Age,* v. 159, May 1, 1947, p. 42-46.

Effect of various types of fluxes on welds made in stainless steel by the atomic-hydrogen process, with flux used in the underside. Causes of these cracks and the detrimental effect of fluxes rich in borates on welding operations in stainless.

22-237. Portable Inert-Gas Metal-Arc Welder. *Iron Age,* v. 159, May 1, 1947, p. 46.

Portable welding unit was specifically built for welding aluminum electrical conductors during construction and assembly operations, but is readily adaptable to other applications. Unit includes the welding transformer, cylinders of argon gas, and connections for the water and drain lines. Electrical control provides protection of the torch against failure of water supply and also starts and stops the argon gas flow and power to the torch.

22-238. Joining Complicated Assemblies in One Operation. *Steel,* v. 120, May 5, 1947, p. 112, 114.

Special multiple spot welding unit welds and "resistance rivets" 26 studs and clips to a stamped steel frame in less than 20 sec., assembling record changers in "record" time.

22-239. Atomic Hydrogen Welding of Stainless Sheet. George Richardson. *Iron Age,* v. 159, May 8, 1947, p. 72-74.

Welding technique and some of the simple but ingenious fixtures used.

22-240. Carbon Soldering Fixtures Cut Rejects, Costs, Labor, Dermatitis. Francis C. Dupre. *American Machinist,* v. 91, May 8, 1947, p. 101-103.

A few examples of their application and results.

22-241. Costing of Arc Welding. R. G. Braithwaite. *Transactions of the Institute of Welding,* v. 10, Feb. 1947, p. 10-12, 18.

The geometry of a weld, the electrode, influence of weld length, influence of electrode size on welding time, electricity consumption, and the use of these factors in quality control.

22-242. Welding of Locomotive Boilers. G. W. McArd. *Welding,* v. 15, April 1947, p. 146-154.

A survey of the general position of the application of welding to locomotive boiler construction. Suggestions as to further developments. Design and technique.

22-243. Oxygen Cutting. Part IX. E. Seymour Semper. *Welding,* v. 15, April 1947, p. 156-163.

Latest type of portable cutting machines; operating technique data.

22-244. Resistance Welding in Mass Production. Part IV. A. J. Hipperson and T. Watson. *Welding,* v. 15, April 1947, p. 164-177.

Electrode types, electrode holders, water cooling, and the arrangement of special electrodes for difficult assemblies.

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Reasons for Use of Powder Metals Given

Reported by F. J. Borgstedt

Consulting Metallurgist

How metal powders are produced by chemical, mechanical and electrical methods was explained by H. W. Highriter, technical director for the Vascoloy-Ramet Corp., in an interesting talk on powder metallurgy. Mr. Highriter addressed approximately 120 members of the Des Moines Chapter ⊕ and the American Society of Mechanical Engineers' student branch at a joint meeting held at Iowa State College on April 8.

"Purity, physical size and shape, and grain size and distribution are important elements in the control of powder processes", he said. Controlled porosity, the mixing of nonalloying metals, reduced machining costs, and very high melting points of the refractory metals are some of the principal reasons for the development and use of powdered metals. Preparation of the metal powders, the additives used, and methods of molding and sintering were described.

Mr. Highriter compared the physical properties of pieces made of powdered metals, and those made by conventional drawing or forging processes. Repeated pressing and sintering develop a tensile strength approximating that of wrought metal.

The preparation and uses of tungsten, molybdenum, tantalum and columbium were explained in detail. Following his talk, Mr. Highriter showed a number of slides.

Secrecy in Cold Deformation Yields To War Exigencies

Reported by Richard Paul Seelig

American Electro Metal Corp.

During an educational lecture before the New York Chapter ⊕, George B. Nisbet of Bethlehem Steel Co. revealed some interesting experiences with steel as it responds to cold deformation in such operations as rolling, bending and deep drawing. While great secrecy formerly surrounded some of the methods used, it became necessary during the war for some large manufacturers to supply engineering skill, and sometimes even tooling, to their subcontractors who did the actual forming work. This practice probably will be continued, Mr. Nisbet opined, particularly on complicated jobs.

In order to assure that a certain steel is suitable for critical applications, its production from the melting to the final temper pass is done under the supervision of a skilled metallurgist. A typical steel contains 0.08% carbon, 0.25 to 0.50% manganese and traces of phosphorus, sulphur and silicon. Tin as an impurity is particularly detrimental to deep drawing; the combination of such elements as chromium, copper, and others also may lead to failures.

Subsequent processing operations are important. For instance, at vitreous enameling temperatures internal stresses may be released resulting in distortion. If the finished article is to be plated, the surface of the material should be as bright as possible. On the other hand, in drawing, a matte finish is advantageous because it holds the lubricant better and shows handling scratches less. The latter surface is superior for paint adherence.

Importance of the grain size and hardness was illustrated by slides. For deep drawing operations approximately 100 grains per sq.in., corresponding to Rockwell B-42 hardness, may be considered a good average. Finer grains are usually too hard and larger ones create an uneven finish.

Named Principal of New School

Dean H. Goard, chairman of the British Columbia Chapter ⊕, has been appointed principal of the proposed Technical Vocational School in Vancouver, B.C. Mr. Goard is at present metallurgist on the staff of the Vancouver Technical School.

22-245. Electronic Control Methods in Welding Applications. *Electronic Industries & Electronic Instrumentation,* v. 1, May 1947, p. 2-3.

Various electronic methods.

22-246. "Two-Tone" Process Explained. W. C. McLott. *Welding Engineer,* v. 32, May 1947, p. 36-40.

Arc process may be used to weld, rebuild or hard face heavy sections of machine parts of a wide variety of purposes. Method uses filler rods in conjunction with an electric arc instead of with the oxy-acetylene torch. The higher, more-concentrated heat of the electric arc melts down and deposits proportionally greater amounts of metal in a given time on worn surfaces.

22-247. Spot Welding Structural Steel. *Welding Engineer,* v. 32, May 1947, p. 53-56.

How resistance welding is being used to replace rivets in steel structures, and how problems of source of electrical energy were solved. Six-part cycle of cleaning or pickling by which the usual rust and scale present on hot-rolled structural steels may be eliminated. Summarizes advantage of three-phase equipment over single-phase.

22-248. Torch Brazing Aluminum. Part I. Harry A. Huff. *Welding Engineer,* v. 32, May 1947, p. 57-61.

The advantages of the process, types of aluminum alloys, joint strengths and corrosion resistance, design problems, jigs, fixtures, and positioners.

22-249. Welding British Submarines. E. Dacre Lacy. *Welding Engineer,* v. 32, May 1947, p. 62-64, 66.

History of the application; arrangement of sections to be welded; slipway layout; prefabricated sections; radiographic inspection of welds; repair work.

22-250. Short Cuts and Kinks. *Welding Engineer,* v. 32, May 1947, p. 70.

Conveyer for atomic-hydrogen welding. Shortening eyebars. Pipe-cutting attachment.

22-251. Weld Repairing Defective and Damaged Castings. *Steel,* v. 120, May 12, 1947, p. 118.

Mogul Arc Bonder, a low-voltage high-amperage unit utilizing compressed air, makes it possible to repair cracked motor blocks, fill blowholes in castings as well as to add metal to aluminum patterns, building up press fits for loose bearings and races and many other operations.

For additional annotations indexed in other sections, see:

6-83; **9**-50; **12**-87; **19**-125; **23**-132-138-142-143-149-153; **24**-133-135-136.

23 INDUSTRIAL USES and Applications

23-125. Zirconium and Thorium Electrodes in Discharge Lamps. H. C. Rentschler, D. E. Henry, and W. C. Lilliendahl. *Electrochemical Society Preprint 91-21,* 1947, 6 p.

The application of zirconium and thorium as electrode materials in cold discharge lamps. Experimental data for evaluating the cause of tube blackening in commercial lamps and the elimination of this condition by zirconium. The use of various electrode materials and their relation to lamp operating characteristics. A method for investigating the cause of deterioration in phosphors.

23-126. Light Alloys As Applied to Mining. W. F. Fennell. *Colliery Guardian,* v. 174, March 21, 1947, p. 327-330.

A number of applications of aluminum alloys in British coal mines. (Abstract of a paper read before the South Wales Branch of the Association of Mining, Electrical and Mechanical Engineers.)

23-127. Die Castings in Industrial Design. H. K. Barton. *Machinery (London),* v. 70, March 27, 1947, p. 325-327.

Various applications of die casting include portable light-weight sewing machine, battery tester, hardware, display plaques.

23-128. Good for Life. *Farm Quarterly,* v. 2, Spring 1947, p. 15-21, 129-132.

Different types of prefabricated metal buildings which are available for farm use.

23-129. Minerals for Chemical and Allied Industries. A Review of Sources, Uses and Specifications. Part VIII. Sydney J. Johnstone. *Industrial Chemist,* v. 23, March 1947, p. 154-162.

Lead, lead pigments, and other lead compounds. (To be continued.)

23-130. Nickel-Manganese-Chromium Steel Wire for Aircraft Control Cables. Henry C. Boynton. *Materials & Methods,* v. 25, April 1947, p. 91-93.

Development of a wire ranging from 0.010 to 0.020 in. in diameter, as strong as Type 304 stainless steel. Analysis of the alloy chosen for this development work. Tables give analyses of specimens tested for coefficient of thermal expansion and thermal expansion of aircraft control cables.

23-131. Processing and Fabrication of Stainless Steel Sheet and Plate Products. Part VIII. H. S. Schaufus and others. *Steel Processing,* v. 33, April 1947, p. 219-224.

Important considerations concerning applications of chromium-nickel sheet and plate materials in ultimate service.

23-132. Assembling 150 Automobile Fenders Per Hour. C. W. Hinman. *Steel Processing,* v. 33, April 1947, p. 232-233.

Short-cut method for assembling sheet-steel parts by spot welding them together.

23-133. Aluminum for Air Ducts. G. W. Birdsall. *Sheet Metal Worker,* v. 38, April 1947, p. 51-53, 99.

Recommendations of alloys, tempers, thicknesses, sizes, as well as handling, fabrication, and erection procedures.

23-134. Photo-Engraving Plates in Magnesium. *Light Metals,* v. 10, April 1947, p. 188-192.

Process-engraving techniques developed for magnesium plates in U.S.A. supplemented by examples of line and half-tone work specially executed by Temple Press, Ltd.

23-135. Aluminum Ducts and Pipes. *Modern Metals,* v. 3, April 1947, p. 16-17.

Plant uses aluminum for heating and sheet-metal work.

23-136. The Aluminum Tension Screen. *Western Machinery and Steel World,* v. 38, April 1947, p. 87-89.

Equipment and procedures used by Ry-Lock Co., Leander, Calif.

23-137. San Jose's Pressure Cooker. *Western Machinery and Steel World,* v. 38, April 1947, p. 90-93, 115.

Structural and working parts of continuous pressure cooker and cooler; more than a hundred thousand sealed cans processed per day.

23-138. In-Line Velvet Transportation. *Western Machinery and Steel World,* v. 38, April 1947, p. 102-106.

Pictures show machining, welding, and assembly operations to produce motor scooters.

23-139. Office Building Initiates Prefabricated Aluminum Facing Over Reinforced Concrete Frame. *Architectural Forum,* v. 86, April 1947, p. 98-101.

Pictures show various steps in construction.

23-140. Wheels and Axles for the Mining Industry. L. Sanderson. *Mine & Quarry Engineering,* v. 13, April 1947, p. 121-122.

Fabrication procedures.

23-141. Some Steels for Gas Turbines. *Aeroplane,* v. 72, April 4, 1947, p. 340-341.

Properties of four ferritic and two austenitic steels made in Britain. Graphs show their properties. Finished parts described and illustrated.

23-142. 1500-Ft. Welded Continuous-Girder Bridge. *Engineering,* v. 163, April 11, 1947, p. 285-286.

Structure near Montreal, Canada, believed to be the longest welded continuous-girder bridge in the world.

23-143. All-Welded Hydraulic Scraper. *Iron Age,* v. 159, April 24, 1947, p. 57.

No castings used in design of unit. Bearing housing welded directly to frame. Other welding applications.

23-144. New York Central Installs 20 Aluminum Alloy Combination Baggage Cars. *Railway Age,* v. 122, April 26, 1947, p. 853-856.

Construction of these cars.

23-145. New Air Marker Installation Heralds New Market for Porcelain Enamel. *Finish,* v. 4, May 1947, p. 27-30.

Description of the marker and installation procedures. Most of the story has to do with development of the C.A.A. project.

23-146. Stainless Steels for Springs. Part I. Harold C. R. Carlson. *Product Engineering,* v. 18, May 1947, p. 103-106.

Properties and workability of stainless steel for springs subjected to corrosive conditions and to elevated or subzero temperatures.

23-147. Kaiser-Frazer Production Innovations. *Automotive and Aviation Industries,* v. 96, May 1, 1947, p. 28-29.

Pictures with brief explanatory notes.

23-148. Steel Truck Body Members Standardized for Mass Production. Nelson E. Cole. *Steel,* v. 120, May 5, 1947, p. 96-99, 124, 126, 129, 130, 132, 134, 137, 138.

Construction method that employs standardized stamped truck-body members and simple fabricating techniques. Flexibility of design enables body builders to meet individual truck owners' requirements, using mass-production facilities for custom-built bodies.

23-149. Modern Motor Manufacturing Methods. H. E. Linsley. *Iron Age,* v. 159, May 8, 1947, p. 68-71.

How all-steel, welded-frame Lifeline motors are produced by the use of continuous automatic equipment in a new, fully conveyerized plant.

23-150. Razor Strip. *Iron and Steel,* v. 20, April 1947, p. 143-144.

Steps from the melting of a 10-ton cast of steel to a finished razor blade.

23-151. Reducing Metal Wear With Abrasion Resisting Castings. J. S. Vanick. *American Ceramic Society Bulletin,* v. 26, April 15, 1947, p. 109-116.

A survey of steels and cast irons possessing special merit as wear resisting materials. Laboratory investigation of these materials. How one industry borrows experience from another is illustrated by an example from the mining industry where records of achievement in abrasion resistance led to the application of Ni-hard in the ceramic industry for muller tires, scrapers, knives, and augers.

23-152. Production Line Methods at Massey-Harris Co. *Production Engineering &Management,* v. 19, May 1947, p. 65-74.

How revamped manufacturing techniques and the addition of new tools and equipment are boosting the output of farm machinery.

(Turn to page 48)

Modern Furnace Designs and Choice Of Fuels Outlined

Reported by Frank Kristufek

U. S. Steel Corp., Research Laboratory

Many interesting applications of combustible fuel furnaces were described and illustrated with lantern slides by Frederick C. Schaefer, sales manager of the American Gas Furnace Co., who spoke at a meeting of the New Jersey Chapter at Newark.

Any temperature employed in the heat treatment of the common metals can be readily obtained in gas or oil-fired furnaces of either the direct or muffle type, stated the speaker. Furnace parts, including muffles, made of heat resisting alloys can be used up to about 1800 to 2000° F.; refractories are satisfactory up to considerably higher temperatures for hearths, walls, and muffles.

According to Mr. Schaefer, the cost of fuels is a guide in their selection but should never be used alone to determine the best fuel for any given conditions; relative convenience and cost of preparation as well as accuracy of temperature control and nature of the product surface obtainable must also be considered. The most suitable combustible fuels are natural gas, liquefied petroleum gas, and artificial gas, although good results may be obtained with oil by care in furnace design and careful supervision of operation.

Modern furnace designs described by the speaker employ a recirculation system for low temperatures (usually under 1100° F.) where heat is generated in a separate chamber by electricity, oil or gas and the resulting hot gases are circulated through the furnace by a fan. Indirect firing is used for all temperatures up to 2500° F., where combustion chambers are located below, at the side of, or above the heating charge and separated from the heating chamber by suitable baffles or full muffles. Muffles permit the introduction of any special gas atmosphere for surface preservation or special treatments.

The use of stacks on heat treating furnaces has been discontinued because modern burners operate on a relatively high positive pressure. Modern combustible-fuel furnaces are equipped with automatic devices to obtain a fixed fuel-air ratio, thus maintaining proper and constant combustion throughout the turndown range. Openings in the furnace automatically adjust themselves to the rate of fuel flow.

Industrial gas carburizing furnaces of the batch or continuous type are extremely flexible in controlling the temperature, case depth, carbon content of the outer case, and carbon gradient of the product. The batch, horizontal, rotating retort type of furnace is used for parts which are not injured by the tumbling action which occurs during the operation; because of the simplicity of the retort section and the absence of trays and fixtures, this method of carburizing is the most economical, according to Mr. Schaefer.

Technical Chairman Philip Osterman conducted the discussion period.

Electroplating

(Continued from page 8)

son makes similar claims for tin-zinc alloy (20% zinc) plates (8-151, Jan. 1947). Fabricators are reminded by Conradi of nickel-zinc diffusion coatings available in preplated sheets (8-114, Nov. 1946).

Seeking refractory plates other than chromium, Hart and Black investigated the iron-tungsten system (8-48, 1945 volume). Although they were unable to produce a high melting point alloy, their work may serve as a basis for future successful investigations. Similar results were obtained with nickel-tungsten alloys by Vaaler and Holt (8-115, Nov. 1946).

Brenner and Riddell have advanced the technology of plating without current. They disclose a new method for controlling the chemical reduction of nickel from its solutions (8-103, Oct. 1946). Yields are attractive for certain intricate shapes, such as small parts not easily tumbled in a barrel, or for lining bores of very small tubes inaccessible to an anode.

23-153. **Quantity Production of Welded Passenger Cars.** A. M. Unger. *Railway Mechanical Engineer,* v. 121, May 1947, p. 236-238.

The resistance welding setup of the Pullman-Standard Car Manufacturing Co. for fabricating passenger cars.

23-154. **Rebuilding Worn Drag Bits.** Elton Sterrett. *Oil Weekly,* v. 125, May 12, 1947, p. 55.

Use of tungsten carbide inserts.

23-155. **Manufacture, Selection and Use of Files. Part I.** L. E. Browne. *Steel,* v. 120, May 12, 1947, p. 102-105, 132, 134.

Various types of files and their manufacture. (To be continued.)

23-156. **Eight Full Openhearth Heats Used in 1100-Ton Magnet for Navy Super-Cyclotron.** *Steel,* v. 120, May 12, 1947, p. 126.

Photographs illustrate some of the steps taken in the production and assembly of eight solid-steel forgings, weighing an average of 150 tons each, for the magnet of the cyclotron.

23-157. **Peacetime Applications of Some of the Lesser Known War-Developed Minerals.** R. J. Lund. *Ohio State University Engineering Experiment Station News,* v. 19, April 1947, p. 45-48.

New applications of uranium, thorium and the rare earths obtained from monazite sand, indium, tantalum, columbium, lithium, silver, boron, platinum, quartz crystals, calcite, and sapphire.

23-158. **Four New Extrusions for Unit Furniture.** George Fejer. *Light Metals,* v. 10, April 1947, p. 184-188.

Four shapes of extrusions and their use in drawer handles, door handles, sliding-door channels and various other furniture applications.

For additional annotations indexed in other sections, see:

3-131-137; 6-99-104; 14-138-145; 19-126-145-150; 20-239; 24-140; 27-96.

24 DESIGN

24-119. **The Design of Steel Castings.** *B.S.F.A. Bulletin,* v. 1, July 1946, p. 2-7.

First issue of the above publication is entirely concerned with elementary principles of casting design and the selection of steels on the basis of physical properties.

24-120. **Abaques pour le Calcul du Bénéfice Apporté par l'Allégement des Carrosseries Industrielles. (Graphic Calculation of Advantages to be Obtained by Decreasing the Weight of the Bodies of Commercial Vehicles.)** H. Colombier and Pierre de Lapeyriere. *Revue de l'Aluminium,* v. 24, Jan. 1947, p. 19-28.

A method for calculation of the optimum weights of industrial vehicles. The method is applied to show the advantages of light-alloy framework for construction of prefabricated bodies of various types.

24-121. **Design of Steel Castings.** *B.S.F.A. Bulletin,* v. 1, Oct. 1946, p. 1-7.

Amount of shrinkage; types of feeder head, directional solidification, and chills.

24-122. **Design of Steel Castings. Hot Tears and Pulls.** *B.S.F.A. Bulletin,* v. 1, March 1947, p. 1-7.

Hot tearing and ways to prevent it by proper design and casting technique.

24-123. **Stress Analysis by Photo-Elastic Methods.** C. Mylonas. *Sheet Metal Industries,* v. 24, April 1947, p. 807-809.

Condensation of a lecture recently given before the Mathematical and Physical Society of University College, London.

24-124. **Stampers Report on Product Redesign.** *Steel Processing,* v. 33, April 1947, p. 225-226, 252.

Cross section of stamping uses indicates the wide range of large and small stampings used in the production of new or redesigned products.

24-125. **Photographic Layout Reproduction.** J. Johnston. *Aircraft Production,* v. 9, April 1947, p. 123-126.

The camera is of British design and manufacture; ancillary equipment installed by Airspeed, Ltd., and operated successfully during the past year.

24-126. **Designing of "Trouble-Free" Dies.** C. W. Hinman. *Modern Industrial "Press",* v. 9, April 1947, p. 20.

A press fit assembling die.

24-127. **The Distribution of Loads on Rivets Connecting a Plate to a Beam Under Transverse Loads.** F. Vogt. *National Advisory Committee for Aeronautics Technical Memorandum No. 1134,* April 1947, 24 p.

A theoretical discussion with descriptions of methods of solution for various cases. Methods recommended for use in the design of light-alloy structures when the design load is likely to be above the proportional limit. (Reprinted from Report SME 3301, Oct. 1944, Aircraft Establishment, Farnborough, England.)

24-128. **The Load Distribution in Bolted or Riveted Joints in Light-Alloy Structures.** F. Vogt. *National Advisory Committee for Aeronautics Technical Memorandum No. 1135,* April 1947, 39 p.

Theoretical discussion which is applicable not only for loads below the limit of proportionality but also for loads above this limit. Methods illustrated by numerical examples. A summary of earlier theoretical and experimental investigations. (Reprinted from SME 3300, Oct. 1944, Aircraft Establishment, Farnborough, England.)

24-129. **Compressive Strength Comparisons of Panels Having Aluminum Alloy Sheet and Stiffeners With Panels Having Magnesium Alloy Sheet and Aluminum Alloy Stiffeners.** Norris F. Dow, William A. Hickman, and Howard L. McCracken. *National Advisory Committee for Aeronautics Technical Note No. 1274,* April 1947, 24 p.

Comparisons show that the composite magnesium-alloy, aluminum-alloy panels have higher structural efficiencies and buckling loads if the stiffeners are widely spaced.

24-130. **Length Changes in Metals Under Torsional Overstrain.** H. W. Swift. *Engineering,* v. 163, April 4, 1947, p. 253-257.

The assumption, that straight radial lines remain straight after torsion, if proven accurate, would justify the construction proposed by Nadai by means of which the stress-strain relationship could be derived graphically from the torque-twist curve. The investigation described arose from some experiments made on mild steel to test the validity of Nadai's construction, by comparing shear stress-strain curves obtained from solid bars by his construction with similar curves obtained from hollow specimens in which the stress distribution could be regarded as uniform. Details of the technique and the results obtained.

24-131. **Battelle Reports on Field Survey.** L. R. Jackson, H. M. Banta, and R. C. McMaster. *Drilling Contractor,* v. 3, April 15, 1947, p. 42-47, 55.

Following a visit to the Permian Basin fields of West Texas and New Mexico, the authors point out the advantages and disadvantages of using drill collars to reduce stresses, and analyze the use of sodium chromate as an inhibitor. They report on the use of internally-coated drill pipe and offer their conclusions and recommendations.

24-132. **Hydraulic Control for Heavy Engine Lathe.** *Product Engineering,* v. 18, May 1947, p. 94-95.

Design features of Hydratrol lathe.

24-133. **Quick-Removable Fastener Redesigned.** *Product Engineering,* v. 18, May 1947, p. 98-99.

Redesigned fastener is made in floating or rigid, flush or plus-flush types that open on a quarter-turn of the coin slot or wing heads. All parts are cadmium plated. Fastener is intended for joining metal sheets.

24-134. **Typical Applications of the Bellows Unit in Control Assemblies.** *Product Engineering,* v. 18, May 1947, p. 116-117.

Basic designs of bellows, and some of their applications in the field of temperature and pressure control.

24-135. **New Torsion Rod Suspension Features Welded Construction.** Given Brewer. *Automotive and Aviation Industries,* v. 96, May 1, 1947, p. 24-27, 84.

Stress analysis and road tests of light-vehicle springing system.

24-136. **Tecnica Costruttiva dei Grandi Serbatoi di Alluminio. (Methods of Construction for Large Aluminum Vessels.)** *Alluminio,* v. 15, Jan-Feb. 1947, insert, p. 1-30.

Summarizes information from Italy and foreign countries. Excellent detail drawings show good and bad designs for welding of various shapes. Pertinent properties of various commercial aluminum alloys. 13 ref.

24-137. **Collapse Resistance of Pipes.** W. F. Schaphorst. *Welding Engineer,* v. 32, May 1947, p. 85.

The external pressure which has a tendency to collapse a steel tube or pipe of specified length, diameter, and wall thickness.

24-138. **Lubrication Considerations in Gear Design.** *Machinery,* v. 53, May 1947, p. 145-153.

Emphasizes need for designer to consider the effect of speed and tooth loading on film-forming ability.

24-139. **Mechanism for Imparting Oscillating Motion to Paper-Cutting Blade.** Charles F. Smith. *Machinery,* v. 53, May 1947, p. 179-180.

Modified oscillating motion imparted to the cutter by design shown was found to be much more suitable for cutting paper than the action of a vertical guillotine-type cutter. The width of the strip is adjustable by ½-in. increments, and as many as 400 strips have been cut per minute.

24-140. **Trailers.** *Automobile Engineer,* v. 37, April 1947, p. 129-136.

More important design features embodied in Taskers trailers. Coupling, axle assemblies, suspension systems, jockey wheels, and braking systems. Manufacturing methods.

24-141. **Unfired Cylindrical Vessels Subjected to External Pressure.** F. V. Hartman. *Transactions of the American Society of Mechanical Engineers,* v. 69, May 1947, p. 337-343; discussion, p. 343-344.

Report of the progress of the Unfired Pressure Vessel Code of the A.S.M.E. Special Research Committee on Vessels Under External Pressure since 1943. New charts for determining the thickness of cylindrical unfired vessels subjected to external pressure when constructed of carbon or low-alloy steel, monel, "A" nickel, Inconel, aluminum (commercially pure grade) and aluminum-manganese alloy. Information for the steels and aluminums includes charts for vessels which operate at elevated temperatures. Proposed rules for the reinforcement of openings, testing of vessels, and odd-shaped vessels.

24-142. **Computing Strength of Vessels Subjected to External Pressure.** R. G. Sturm and H. L. O'Brien. *Transactions of the American Society of Mechanical Engineers,* v. 69, May 1947, p. 353-358.

(Turn to page 50)

New Alundum Has High Purity, Rough Crystal Surface

Reported by Ray E. Cross

Chief Metallurgist, Michigan Light Alloys

The synthesis of silicon carbide around 1900 and fused aluminum oxide a little later opened up a new field in synthetic abrasives, A. O. Bush, chief sales engineer of the abrasive division of the Norton Co., told the West Michigan Chapter at its April meeting. A grinding wheel or abrasive "tailor made" for any given application is now possible with the controlled-purity aluminum oxide produced in the electric furnace, silicon carbide, and a combination of one of the common bonding materials such as clay, glass, rubber, silicates, shellac, or resinoid.

Aluminum oxide is produced in several forms: *(a)* the strong type, or regular Alundum, *(b)* the porous, easily fractured, cool cutting type or 38 Alundum, and *(c)* the recent high-purity (99.6%) crystalline 32 Alundum, which combines many of the desirable characteristics of the others.

The 32 Alundum is crystallized out of solution at about 1800° C. and forms individual crystals in a soluble sulphide matrix that readily disintegrates at room temperature with water or natural weathering. It thus eliminates the usual crushing operation required with large cast ingots, and preserves the natural rough, nubbly, crystal surface.

Mr. Bush pointed out that there is no general rule in the selection of abrasives. Experience has shown that silicon carbide wheels work best on cast iron, while aluminum oxide wheels work best on steel.

In conclusion, a short color film showing the manufacture and advantages of 32 Alundum was shown.

Shows How 15 Processes Meet Most Requirements

Reported by Richard Paul Seelig

American Electro Metal Corp.

A subject which might be called "Methodizing for Mass Production of Small Parts" was presented in the final educational lecture of the New York Chapter course. Fred P. Peters, editor-in-chief of *Materials and Methods*, compared some 15 different processes on the basis of cost, size, tolerance, quantity, materials, properties, and tooling.

Good working knowledge of all of these methods is essential for the designer who has to make the selection, he said. The number of variables which enter into the equation is so large that it is impossible to predict the result without careful study.

Mr. Peters selected a list of requirements and indicated what methods would be most likely to answer them, all other factors being equal. For instance, if mechanical strength is the predominating specification, the engineer is likely to select forging, or perhaps precision casting. He will not be inclined to choose powder metallurgy. If, on the other hand, dimensional accuracy is the outstanding requirement, screw machining, powder metallurgy, and die casting are among the likely methods whereas sand casting or assemblies would be unfavorable processes.

If speed of production is of the essence, stamping, cold heading and die casting are typical, whereas assemblies and precision castings would not be chosen. Tool cost—very important where quantities are not extremely high—is a criterion favorable to precision casting, spinning, sand casting and extrusion, but unfavorable to die casting, powder metallurgy and drop forging.

Accuracy obtainable with the various manufacturing methods depends so largely upon shape, size and—last but not least—cost of the article that it is difficult to establish definite rules. In almost all instances greater precision is possible if competitiveness is not essential.

Variables and considerations that must be treated when designing a pressure vessel for a collapsing load. Collapsing-pressure diagrams and the formula used in determining values. A method is presented which eliminates trial-and-error solutions by use of appropriate charts based upon instantaneous moduli of elasticity. Calculations and charts are shown for "A" nickel and stainless steel 17-7.

24-143. Vibration Testing and Product Acceptability. Harrison Johnston. *Iron Age,* v. 159, May 15, 1947, p. 58-61.
Some of the possible consequences of excessive vibration, and the various types of testing equipment available, their ranges and typical applications.

For additional annotations indexed in other sections, see:
12-88; 14-137; 19-148-150; 20-240; 22-242; 23-127-142.

25 MISCELLANEOUS

25-61. Engine Assembly. *Automobile Engineer,* v. 37, March 1947, p. 90-97.
System employed in the marshalling stores at Austin Motor Co., Ltd. The stock turnover and size of the contingency stocks. Interesting transport and storage facilities. Assembly lines.

25-62. Material Handling in the Structural Shop. E. O. Thomas. *Fasteners,* v. 4, no. 1, 1947, p. 15-17.
Facilities available at Moore Dry Dock Co. and Belmont Iron Works.

25-63. Research in Physical Metallurgy. G. S. Farnham. *Canadian Mining and Metallurgical Bulletin,* April 1947, p. 205-214.
Outstanding developments since World War I, and comparison of Canada's efforts with those of England, Germany, and the United States.

25-64. The Hands of Cranes and Hoists. *Flow,* v. 2, May 1947, p. 22-24, 26.
Widely used, basic designs for the "grabs" of overhead handling equipment.

25-65. Continuous Flow for Axle Housings. *Flow,* v. 2, May 1947, p. 30-33, 64.
Materials-handling system used by Midland Steel Products Co., Cleveland, during fabrication of automotive axle housings.

25-66. Modernizes Malleable Iron Foundry. Erle F. Ross. *Foundry,* v. 75, May 1947, p. 72-76, 222, 224, 226.
Describes modernized foundry of Oliver Corp., Chicago. Outstanding features are maximum utilization of mechanical handling of raw materials; and conveyerization of molds, pouring operations, and castings processing.

25-67. A Plan for Cutting Production Cost. S. W. Gibb. *Iron Age,* v. 159, May 1, 1947, p. 54-57.
A simple three-step plan which enables management to spot expensive and time-consuming handling situations and to plan corrective action.

25-68. Mellon Institute Enters the Postwar Era. *Chemical and Engineering News,* v. 25, May 5, 1947, p. 1265-1270.
Review based on the contents of the 34th Annual Report of the Director. Work was done in pure chemistry, chemical physics, ceramics, metallurgy, fuels, protective coatings, and other fields.

25-69. Engineering Approach to Materials Handling. R. W. Mallick and J. H. Sansonetti. *Steel,* v. 120, May 5, 1947, p. 102-103, 144-146.
Example cited involves the shipping of motor brackets from one foundry to another plant about 150 miles away. Development of collapsible-type container resulted in 45% saving, while breakage was reduced to less than 2%. (From paper presented before Materials Handling Exposition, Cleveland, Jan. 16, 1947.)

25-70. Three Systems for Handling and Storing Metal Chips. S. Reibel. *Transactions of the American Society of Mechanical Engineers,* v. 69, May 1947, p. 413-420.
An aluminum-chip pneumatic handling and carloading system; a mechanical method of disposing of steel chips and turnings; and a new system of mechanical handling with gravity carloading features.

25-71. Method of Mechanical Handling of Gear Blanks at Westinghouse. O. P. Adams. *Machine and Tool Blue Book,* v. 43, May 1947, p. 151-152, 154, 156.
A picture-story of Westinghouse's efficient method of assuring a smooth flow of production from fabrication of gear blanks to final packing.

26 STATISTICS

26-65. South American Minerals in the World Economy. Pedro G. Beltran. *Metals,* v. 17, April 1947, p. 7-8, 17.
The mineral industries of the different South American countries, and opening of American market to South American producers.

26-66. Forecast on New Metals and Alloys. (Concluded.) Zay Jeffries. *Metals,* v. 17, April 1947, p. 11-13.
Address delivered before The American Institute of Mining and Metallurgical Engineers.

26-67. With Respect to Metals, Era of Plenty in U. S. Has Given Way to Era of Deficiency. J. A. Krug. *Metals,* v. 17, April 1947, p. 14-15.
Urges more extensive search for minerals, acquisition from other sources of metals we lack, and building up stockpile.

26-68. 1946 Lake Superior Iron Ore Shipments by Companies. *Skillings' Mining Review,* v. 36, April 26, 1947, p. 1-2, 4, 9, 13.
A compilation of statistics.

For additional annotations indexed in other sections, see:
27-95-99-103.

27 NEW BOOKS

27-89. Roentgenographisch-Analytische Chemie. (X-ray and Analytical Chemistry.) E. Brandenberger. 287 p. Verlag Birkhaeuser, Basel, Switzerland.
Differs from other publications in that it does not show how the tests are actually performed but only demonstrates what problems in chemical investigation can be solved by means of X-ray analysis. It also shows what answer can be expected in a specific case and the assumptions for application of this technique. A minimum of mathematics is used and frequent use is made of diagrams and lattice schemes. References to the literature are given following each paragraph.

27-90. Spanabhebende Metallbearbeitung. (Metalworking by Chip Producing Methods.) A. Michalik and L. Eberman. 222 p. 1944. Schweizer Druck- und Verlagshaus, Zurich, Switzerland.
A good introduction to the field of metalworking for apprentices and young technicians.

27-91. Bibliography of the Platinum Metals. 1918-1930. James Lewis Howe and others. 138 p. Baker & Co., Inc., Newark, N. J. $5.00.
References are arranged alphabetically according to author for each year. Some of them include brief annotations. There is a subject index.

27-92. Stress-Corrosion Cracking of Mild Steel. James T. Waber and Hugh J. McDonald. 94 p. Corrosion Publishing Co., 1131 Wolfendale St., Pittsburgh, Pa.
A series of seven extensively referenced articles recently published in *Corrosion and Material Protection,* a collection of contributed criticisms, and the authors' replies. A general "precipitation" theory of stress corrosion is developed which states that high local stresses induced by the presence of a crack accelerate the formation of a galvanic cell, by accelerating precipitation, and the crack grows by the dissolution of newly formed anodic material.

27-93. The Rare-Earth Elements and Their Compounds. Don M. Yost, Horace Russell, Jr., and Clifford S. Garner. 92 p. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $2.50.
The principal chemical and physical properties of the rare-earth elements and their compounds; the agreement of current theories with these properties. Chemical properties, methods of separation, preparation, reactions, and solubilities. Frequent references to the literature. It is assumed that the reader or student is thoroughly familiar with modern physical chemistry and physics.

27-94. Proceedings of the American Electroplaters' Society, 33rd Annual Technical Sessions, Pittsburgh, Pa., June 1946. 304 p. American Electroplaters' Society, Jenkintown, Pa. $6.50.
Contains technical papers, discussion, and remarks. Individual papers have all been annotated in Sections 7 and 8 of the Review of Metal Literature. Those papers that were preprinted or previously published in other sources were listed at the time of first publication. All papers not prepublished in such manner are listed in the Review of Metal Literature at time of publication of the bound volume of the *Proceedings.*

27-95. Novena Memoria Anual. (Annual Report of the "Banco Minero" of Bolivia for 1945.) 35 p. Banco Minero de Bolivia, La Paz, Bolivia.
Survey of prices and export of minerals and metals produced in the Republic of Bolivia during the year 1945; namely, tin, antimony, tungsten, lead, silver, gold, and asbestos.

27-96. L'Aluminium dans les Réseaux de Distribution a Moyenne et Basse Tension. (Aluminum in Medium and Low-Tension Electric-Current Distribution Networks.) 138 p. L'Aluminium Francais, 23 bis, Rue Balzac, Paris, France.
Increasing utilization of aluminum for the above in France since 1930. The various types of aluminum-containing conductors and their applications. Their properties are compared with those of copper conductors and instructions are given for their installation.

27-97. Technology of Refractories. V. I. Perevalov. 528 p. State Scientific-Technical Publishing Home for Ferrous and Nonferrous Metallurgy, Moscow, U.S.S.R. (In Russian.)
College text analyzes properties of the raw materials used by the refrac-

(Turn to page 52)

Three Classes of High-Temperature Alloys Described

Reported by C. Gordon Hoffman

Product Metallurgist
American Steel & Wire Co.

Four important factors to be considered in applications of "High-Temperature Alloys" were enumerated by Howard C. Cross, supervisor in the metallurgical division of Battelle Memorial Institute, before the Cleveland Chapter ⊕ on May 3. These factors are temperature, stress, service life, and permissible deformation.

Several tests for high-temperature applications are short-time tensile, stress-rupture, creep, fatigue, oxidation, corrosion, and thermal effects such as expansion and conductivity. A suitable high-temperature alloy must have a strong austenitic matrix and fine precipitates for strengthening effects, Mr. Cross pointed out.

There are three main classes of these alloys:

1. Modified 18-8 (Cr-Ni) or 8% Cr, 18% Ni alloys hardened by additions of molybdenum, tungsten, titanium and columbium. These alloys are "hot cold worked"—that is, the working temperature of 1200 to 1400° F. is "cold" working for these alloys.
2. Heat treating alloys—namely, *(a)* chromium-nickel-iron, *(b)* chromium-nickel-cobalt iron, *(c)* nickel-molybdenum-iron, and *(d)* nickel-base. All of these alloys must be heat treated for optimum strength at high temperature.
3. Cast alloys—cobalt-base containing chromium and nickel, with strengthening additions of molybdenum, tungsten and columbium. Casting is a natural for these cobalt-base superalloys, since machining or working is difficult. The casting and mold temperatures are extremely important in establishing their physical properties.

Stress-rupture properties at higher temperatures are generally progressively better for the three classes of alloys. Much work is being done on the chromium-base alloys, vacuum cast. These alloys have extremely good stress-rupture and creep properties at 1600° F. For applications above 2000° F. the chromium-nickel alloys appear to be as good as the superalloys.

In closing, Mr. Cross emphasized the work being done on the theoretical basis of the properties of these alloys. For example he cited the studies on the phase systems of the various alloys—investigations which are both difficult and painstaking.

Handy & Harman Opens New Plant

Handy & Harman opened a new West Coast service plant on March 11 at 3625 Medford St., Los Angeles 33. It will house both sales department and manufacturing facilities for users of precious metals. H. A. Folgner is manager.

Illinois Inst. of Technology Opens Metallurgy Dept.

Illinois Institute of Technology has established a new curriculum in metallurgical engineering. Inauguration of this curriculum in the fall will coincide with the opening of a new building in which 11,000 sq.ft. will be devoted to metallurgical engineering laboratories.

Laboratories include heat treatment, welding and foundry, metal shaping, mounting and grinding, polishing, etching, microscope, photomicrograph and X-ray, electrometallurgy, powder metallurgy, mechanical testing, radiography and magnaflux, dark rooms and storage. The metallurgy building also provides classrooms, lecture rooms, lounges and reading rooms, conference rooms, and a library.

Industries of the Chicago area have contributed not only funds, but teachers for the evening division, and counseling for both undergraduate and post graduate employment.

Speaks on Salt Quenching

Reported by Glenn E. Pelton

Metallurgical Department
Willys-Overland Motors, Inc.

"Isothermal Salt Quenching" was the subject of an address by H. J. Babcock, research engineer of the Ajax Electric Co., before the Toledo Group of the Detroit Chapter of A.S.M. Mr. Babcock reviewed the formation of S-curves and traced the expansion of salt bath quench tanks from laboratory models to commercial sizes. Rate of cooling in quenching in relation to obtained hardness, and the importance of movement in quenching were covered.

Modern Annealing and A.S.M. Affairs Discussed

Reported by J. D. McNair

Plant Metallurgist
Indiana Steel and Wire Co.

A double-barreled program featured the March meeting of the Muncie Chapter ⊕. The coffee speaker, Arthur Focke, national A.S.M. trustee, condensed a full-length lecture into an inspiring short address. He analyzed how each class of members—technical, executive, teaching, or sales—benefits from the American Society for Metals, and outlined what each could and should contribute to the society.

James Kerney, plant metallurgist, Atha Works, Crucible Steel Co. of America, presented the technical address on "A Modern Viewpoint of Annealing". (Peter Payson, who had been announced, fell afoul of the Muncie Chapter curse, and spent the evening in a hospital with an infected foot.) Mr. Kerney's talk followed essentially the same outline as that presented before several other A.S.M. chapters by Mr. Payson.

tory industry, modern commercial production methods and equipment, and the fundamental principles of the reactions taking place during the manufacture of refractories.

27-98. Engineering Problems Manual. Edition 4. Forest C. Dana and Lawrence R. Hillyard. 432 p. McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y. $3.25.

The revisions are based upon war-inspired experiments.

27-99. Steel Expansion for War. W. A. Hauck. 192 p. *Steel*, Book Department, Penton Building, Cleveland 13, Ohio. $2.00.

Official and authentic report on expansion of the steel industry for the 5½ years from Jan. 1, 1940 to June 30, 1945. The added capacity and cost of every steelmaking facility built during the war. List of companies making every type of finished steel product, plus latest data on new mills now being constructed. Information on new and revamped facilities of hundreds of plants, including those in ore, ore transportation, coal and coke, refractory, ferro-alloy, scrap, foundry, and forging industries. Illustrated and contains numerous charts and tables.

27-100. The Coloring of Metals. Parts I and II. 148 p. Hood Pearson Publications, Ltd., London, England. 3s 6d.

Technical guidance handbook is the first of a series being published for the use of those engaged principally in the metallurgical and allied fields. Part I refers to the more practical aspects of coloring steel, iron, copper, brass, white metals, zinc, and die castings, whereas Part II contains details of laboratory experimental work, and discusses mainly various blackening processes and the multicoloring of anodized aluminum. The review criticizes the manner of presentation, the lack of references, and the lack of colored plates, in view of the subject. (From review in *Industrial Chemist*, v. 23, March 1947.)

27-101. Metallurgy. A Scientific Career in Industry. 36 p. Fanfare Press, London, England.

Booklet designed to point out the advantages of a metallurgical career to the science student who usually hears more about possibilities in basic fields such as chemistry and physics. British point of view makes it of doubtful value for vocational guidance in this country.

27-102. Accident Prevention Manual for Industrial Operations. 544 p. National Safety Council, 20 N. Wacker Dr., Chicago, Ill.

Prepared primarily for the manufacturing industries. Fourteen major subjects covered in the manual are as follows: plant design and layout; construction and demolition; permanent handling and storage; electrical hazards; chemical hazards; fire and explosion hazards; flammable liquids; hand and portable power tools; commercial vehicle operation; personal protective equipment; industrial hygiene; and safety organizations and programs. (From review in *Modern Machine Shop*, v. 19, May 1947.)

27-103. The Steel and Steel-Using Industries of California. E. T. Grether. 408 p. California State Reconstruction and Reemployment Commission, Printing Division, Documents Section, 11th and O Streets, Sacramento 14, Calif.

Results of an extensive survey. However, they are considered to be tentative and exploratory, since the steel-using industries were sampled rather than investigated in their entirety.

27-104. Radiography in Modern Industry. 122 p., illus. Eastman Kodak Co., X-Ray Division, Rochester 4, N. Y. $3.00.

A fundamental text on radiographic practice, well illustrated by photographs, diagrams and charts. Bibliography and index included.

MATERIALS INDEX

The following tabulation classifies the articles annotated in the A.S.M. Review of Current Metal Literature according to the metal or alloy concerned. The articles are designated by section and number. The section number appears in bold face type and the number of the article in light face.

General Ferrous

2-80-81-86-87-88-90-91; **3**-140-141; **5**-29-30; **6**-75-78-86-90-101-103; **7**-186-187-194; **12**-78-83; **13**-22; **16**-61; **18**-85-99; **19**-151; **25**-70; **26**-68; **27**-99-103.

Cast Iron

2-87; **4**-59; **6**-105; **14**-118-125-135-137-141; **20**-212-213; **22**-235; **23**-151; **25**-66.

Cast Steel

14-126-128-135-141; **20**-213; **23**-140-150-151; **24**-119-122.

Wrought Carbon Steel

3-124; **6**-79-100-104; **9**-52-53; **11**-47; **12**-80-87; **14**-137; **18**-88-94-96; **19**-127-131-134-137-142-143; **20**-212-213-238-252-253; **21**-43; **22**-227-231-238-247; **23**-132-140-148-156; **24**-137-141; **27**-92.

Alloy Steel

2-89; **3**-116-119-123-128; **6**-89-96; **7**-186; **10**-79; **11**-47; **18**-84-86-91; **20**-213; **23**-130-141; **24**-141.

Stainless and Heat Resisting Steel

3-116-120-127-136-138; **6**-81-82; **7**-183-186; **10**-74; **19**-138-140-145; **20**-212; **22**-234-236-239; **23**-131-141-146; **24**-142.

Toolsteel and Carbides

3-143; **4**-51; **5**-28-33; **18**-87; **20**-221-228-233-251-254; **23**-154.

General Nonferrous

3-124; **8**-75; **9**-53; **14**-135; **19**-147.

Aluminum

2-78; **3**-126-131; **4**-56-57; **6**-79-83-84-97-99; **7**-162-180-181-186-188; **8**-63; **10**-71-75; **11**-58; **14**-123-143; **15**-15; **18**-92; **19**-120-124-125; **20**-212-245; **22**-228-230-237-248; **23**-126-133-135-136-139-144-158; **24**-120-127-128-129-136-141; **25**-70; **27**-96.

Magnesium

3-137; **4**-56; **6**-85-92; **7**-171; **8**-63-192; **14**-119-139; **18**-89; **19**-122-123-126-139; **20**-212-252; **22**-228; **23**-134; **24**-127-128-129.

Nickel and Nickel Alloys

3-115-141; **4**-53-59; **5**-26-27; **6**-82-91-105; **7**-186; **8**-61-66-69; **9**-51; **10**-82; **22**-235; **24**-141-142.

Copper, Brass and Bronze

1-58-63; **2**-83-85; **3**-115-125-134-141; **4**-49-53; **6**-79-82-105; **7**-165-186-188-191; **8**-61-77; **9**-57; **10**-69-84; **14**-126-129-134-142-144; **18**-93; **19**-144; **20**-210-212-214.

Lead and Lead Alloys

1-54-60; **2**-82; **3**-130; **6**-79; **7**-188; **10**-81-86; **23**-129; **27**-95.

Tin and Tin Alloys

1-59; **3**-117-130; **6**-79; **8**-71-72; **18**-88; **27**-95.

Zinc and Zinc Alloys

1-60; **2**-84; **3**-118; **4**-50-58; **6**-88; **7**-161-168-188; **8**-59-63; **10**-69-84-86; **19**-121-136.

Miscellaneous and Minor Metals

1-53-55-57-61; **2**-77-79; **3**-136-138-141; **4**-48-54-55; **6**-91; **7**-186; **8**-60-67-68; **10**-73; **19**-123; **23**-125-157; **27**-91-95.

Use of TTT-Curves In Quench Explained

Reported by G. F. Kappelt
Assistant Metallurgist
Bell Aircraft Corp.

The benefits that can be derived from the use of TTT-curves in heat treating, as well as the method of deriving and using them, was explained before the Buffalo Chapter at a recent meeting by Arnold P. Seasholtz of the Seasholtz Metallurgical Service Co. in his talk on "Conventional Versus Interrupted Quenching".

Mr. Seasholtz showed how the nose of the TTT-curve has to be missed in order to prevent the formation of free ferrite. If free ferrite is found in the structure, then the elongation, reduction of area and endurance life values will be affected adversely. In many applications, these lower properties will be sufficient to cause service failures.

With regard to martempering and austempering, Mr. Seasholtz showed how the Ms point is a function primarily of the carbon content of the steel. The general rule which applies is that the Ms point varies inversely with the carbon content.

Mr. Seasholtz was of the opinion that there is very little difference in properties between a good tempered martensitic structure and bainite produced by an interrupted quench. The chief danger to be avoided in producing the former structure is a quenching procedure which will produce microscopic cracks in the martensite needles. Such cracks, according to the speaker, will definitely lower the impact value of the steel in which they are found.

Man-Hour Savings Ratio Is 150:1 on Powder Metal Job

Reported by G. W. Birdsall

Manager, Technical Editorial Service
Reynolds Metals Co.

A wealth of information on powder metallurgy was presented by Harry W. Highriter of Fansteel Corp. and Vascoloy-Ramet Corp. before the Louisville Chapter on April 1. Mr. Highriter's talk is briefly outlined on page 45 of this issue.

He cited use of highly porous powdered metal parts for filters as an example of the controlled porosity possible, and the distribution of copper particles in carbon brushes for electric motors as an example of the possibility of combining immiscible materials.

Equally important, he said, is the ability to compact metal to exact shape and dimensions so that machining is greatly reduced. On one job, 68 men using powder metallurgy methods produced in three months the same number of parts that it was estimated would have taken 2500 men a whole year to produce by conventional methods—a 150:1 ratio on a man-hour basis.

Turning to preparations of the powders, molding and sintering, Mr. Highriter said that the "flow" characteristic of the powder is one of the most important, for that determines how it will act during compacting in the dies. Usually a lubricating material is added to aid in pressing, and the powders are then granulated to improve uniformity of flow.

Sintering furnaces for treating the powder metal compacts usually employ a protective atmosphere. Pure hydrogen is good for much work, although cracked gases and other atmospheres are also used. Parts are coined or sized to final dimensions, often without any machining.

As an example of physical properties obtainable, the speaker compared Armco ingot iron with a density of 7.81 and ultimate tensile strength of 39,000 psi. to a part made of electrolytic iron powders, re-pressed and resintered to a density of 7.87 and 50,000 psi. tensile strength. The better properties result partly from the use of purer materials and partly from the finer grain size obtained (70 grains per sq.cm. for Armco iron against 430 for the sintered part).

Standards List Issued by Bureau

The National Bureau of Standards has added two new metals to its list of analyzed standard samples.

A complete list of the standards, fees, and other information is given in the Supplement to Circular C398 which can be obtained free of charge upon application to the Bureau, Washington 25, D. C.

Boegehold, Eisenman Get the Axes

Sportsmen's Axes Were Presented to National President Boegehold and Secretary Eisenman at the May Meeting of the Ottawa Valley Chapter. The handles were cast of magnesium at the Bureau of Mines, Ottawa, and the axes made by Burgess Tools, Ltd., owned by G. T. Burgess, new vice-chairman of the chapter. Left to right are A. L. Boegehold; Mr. Burgess; N. C. MacPhee, retiring chairman; E. W. Marshall, secretary-treasurer; Mr. Eisenman; and C. S. Parsons, director of the Bureau of Mines

Austenizing Temperature Determines Best Results From Intensified Steels

Reported by Frank Kristufek

U. S. Steel Corp. Research Laboratory

The amazing effect of a minute amount of boron on the response of hypo-eutectoid steels to hardening was discussed by Raymond A. Grange, research metallurgist of the U. S. Steel Corp. Research Laboratory, in his talk on "Intensified Steels" at the March meeting of the New Jersey Chapter at Newark.

Boron increases hardenability in amounts from 0.001 to 0.003%; larger quantities have no effect on hardenability but impair some mechanical properties and cause hot shortness in steel. Maximum benefit of boron in plain carbon hardenable steels is greater the lower the carbon content (at least down to 0.40%).

Austenizing temperature is important, since boron-treated steels may suffer a permanent loss in hardenability if heated for a long period at abnormally high temperatures. The increase in hardenability produced by boron is greatest when the austenizing temperature is 1550 to 1700° F., but gradually diminishes, and may finally disappear at temperatures above 2000° F. However, appreciable loss in this hardenability effect is seldom encountered in commercial processing.

The increase in hardenability of intensified steels only roughly correlates with the percentage of boron as determined by chemical analysis, but Mr. Grange described a simple metallographic test to detect amounts as small as 0.0004%. Boron is indicated by a characteristic constituent which appears as a row of fine dots at the austenite grain boundaries. However, the speaker stated that neither the metallographic test nor chemical analysis is entirely adequate for accurately predicting hardenability.

The reason that a minute percentage of this element is so surprisingly effective may be because the boron atoms are principally located in the grain boundaries and are not randomly distributed throughout the austenite. According to the speaker, their presence there lowers the rate of grain boundary nucleation—which is the controlling factor in the upper region of rapid transformation—and thus increases hardenability.

..rious Grades of ..oated Electrodes Used to Weld Copper

Reported by J. W. Sweet

Chief Metallurgist, Boeing Aircraft Co.

Latest developments in arc welding copper and copper-base alloys were outlined before the Puget Sound Chapter ⊕ by W. E. Claflin, welding engineer for Ampco Metal, Inc.

Various grades of coated aluminum bronze welding electrodes have been developed to give weld deposits of varying degrees of strength, ductility, and hardness, he said. These electrodes may be used as metallic-arc electrodes or as filler rods for carbon-arc. Of the two methods the metallic-arc is preferred.

The most ductile grade of electrode is used for welding dissimilar metals, for repairing defects in brass and bronze castings, for welding manganese bronze castings, and for welding brass sheet and plate. The harder grades are used for overlays on various types of bearing surfaces, the hardest being used on forming and drawing dies where scratching or galling of the work must be avoided.

Another development of interest is the shielded, metallic-arc, phosphor bronze electrode for high-speed quality welding of bronzes, brasses, copper, steel, cast iron and malleable iron. It is recommended for the welding of dissimilar metals.

Following the lecture, a color and sound film, "Golden Horizons", showing the history and development of copper-base alloys, was presented.

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad will be printed. Address answers care of A.S.M., 7301 Euclid Ave., Cleveland 3, Ohio, unless otherwise stated.

POSITIONS OPEN

East

ASSISTANT OR ASSOCIATE PROFESSOR: Met. degrees required. Exp. in teaching and physical met. desirable. Salary depending on qualifications. 9 mo. regular school, 6 weeks summer school. In Virginia. Box 6-5.

PART-TIME INSTRUCTORS: Two wanted. B.S. degrees in met. eng. required. ⅓ to ½ time teaching, remainder on grad. work leading to M.S. degrees in met. eng. Salary on basis of $2136 for 9 mo. on full teaching load. G.I. benefits additional. In Virginia. Box 6-10.

RESEARCH ASSISTANTSHIP: Half time fundamental research in physical met. and half on grad. study leading to M.S. or Ph.D. during the school year, full-time research in summers. $1500 or up for 50 weeks plus free tuition. Open to men in upper third of graduating class. Start July or Sept. Also, one laboratory assistantship, $1200 for Sept. to June—open to grad. students. Box 6-15.

EXCELLENT OPPORTUNITY: For metallurgist who wishes to work as a national trade association secretary, New York City. Should have heat treating exp., good personality and like to meet people. Box 6-20.

METALLURGIST: Ph.D. or equivalent. To direct met. research and development activities of government lab. Must have proven administrative ability and broad exp. in both ferrous and nonferrous met. with particular emphasis on light alloys and heat resisting metals. F. S. Williams, Naval Air Experimental Station, Naval Air Material Center, U.S. Naval Base Station, Philadelphia 12, Pa.

FURNACE ERECTION SUPERINTENDENT: Capable and exp. in supervising the erection of continuous industrial heat treating furnaces. Must travel anywhere in the U.S. Knowledge of oil and gas burners and temperature control equipment required. R-S Products Corp., Att.: F. L. Feldmeth, Jr., 4530 Germantown Ave., Philadelphia 44, Pa.

METALLURGIST: College grad. with several yr. exp. in the aircraft industry on control of materials, processes and process inspection. To assume charge of quality control. Expanding aircraft concern with an excellent future. T-99, P.O. Box 3495, Philadelphia 22, Pa.

Midwest

MANAGEMENT ENGINEER: Spring and wire specialist. Age 30 to 45. Ability to deal with top management. Grad. engr. preferred. Foreman training, production standards, incentive plans, methods. Forceful personality, able to motivate people. Detroit area. Some traveling. Send complete information including salary expected. Box 6-25.

MANAGEMENT ENGINEER: Foundry exp. in gray iron. Age 30 to 45. Ability to deal with top management. Grad. engr. preferred. Foreman training, production standards, incentive plans, methods. Forceful personality, able to motivate people. Detroit area. Some traveling. Send complete information and salary expected. Box 6-30.

METALLOGRAPHER: Or exp. lab. assistant for research work on high-temperature alloys. Salary open. University. Box 6-35.

COLLEGE GRADUATES: In met., chem., and welding eng. for full-time research and development work. Opportunity for free tuition to evening graduate courses at Illinois Institute of Technology. Metals Division, Armour Research Foundation, Technology Center, Chicago 16, Ill.

RESEARCH FELLOWSHIPS: Available at midwestern university to qualified candidates for the M.S. or Ph.D. degree in physical met. Box 6-40.

DEVELOPMENT METALLURGIST: For copper-base alloy development. Exp. in production and development work required. College grad. with knowledge of melting, casting, heat treating and processing. Write full particulars about qualifications and salary desired. Milwaukee area. Box 6-45.

RESEARCH ASSISTANT: Grad. metallurgist or physical chemist, for full-time work on liquid metal and slags. Opportunity for tuition-free advanced study in night school. Give full qualifications and salary required in letter. Metals Research Laboratory, Carnegie Institute of Technology, Pittsburgh 13, Pa.

FOUNDRY SUPERVISORS: And young men with met. and mech. eng. backgrounds who would be interested in a course of training leading to fdry. supervisory positions. If interested, write stating qualifications and making arrangements for an inter view. Box 6-50.

POSITIONS WANTED

METALLURGIST: B. M. Eng. and M.S. in metallography. Age 25, single. 3 yr. exp. in trouble shooting, physical testing, materials selection and heat treatment of ferrous metals. Desires position in development work. Location immaterial. Box 6-55.

METALLURGIST—FOUNDRY SUPERVISOR: B.S. degree. Married, age 25. Exp. in gray iron production fdry. and supervisory work, sand problems, power plant operation. Three years as naval eng. and executive officer. Desires permanent position with responsibility, advancement and commensurate salary. Location immaterial. Box 6-60.

SALES ENGINEER: Now selling gray iron and nonferrous castings in the eastern Pa. area for reputable firms. Desires to add steel and malleable iron castings to present lines. Particularly interested in steel fdry. making both carbon and stainless castings. Well-established following and practical background in modern fdry. methods. Box 6-65.

METALLURGIST: Seeks connection with an organization in which 20 yr. exp. with nonferrous metals and stainless steel can be employed usefully. Not interested in lab. research; prefers consulting or technical service work. Box 6-70.

SALES REPRESENTATIVE: Age 41, college grad. Exp. foundryman wishes sales connection with fdry. supplies, pig iron, coke, sand. Ohio territory preferred. Columbus resident. Box 6-75.

METALLURGICAL ENGINEER: Honor university grad. 3 yr. fdry., forging and metallography exp. Desires teaching position in met. Box 6-80.

LITERATURE AND PATENT EXPERT: Specializing in met. and chem. will undertake full or part-time duties in Washington, D.C., area only. Facilities unexcelled. Available also as Washington representative or related functions. 12 yr. bibliographic, met. and chem. research, sales and advisory exp. Inquiries solicited. Please designate desires. Box 6-85.

FOREMAN: Heat treater with 30 yr. practical exp. in production and commercial heat treating of all grades of steel. Eastern location preferred but will go anywhere. Box 6-90.

EXECUTIVE ENGINEER: Desires position with progressive co. wanting to increase production by the development of methods and equipment. Applicant has fine record of accomplishment. Will go anywhere in the world. Box 6-95.

METALLURGIST: B.S. 1941. Excellent background in ferrous physical met. with 3 yr. industrial exp. and 2½ yr. exp. in research and development. Exp. in all phases of heat treating, physical testing, and high-temperature testing. Desires responsible position as plant metallurgist or in position offering research and development. $4000 min. Box 6-100.

TEACHER: Chemist, metallurgist. Age 35. Ph.D. 5 yr. inorganic analytical and colloidal chemistry teaching; 5 yr. chem. and met. industrial research exp. Wishes position which will emphasize teaching; some research. Available in Sept. Box 6-105.

CANADIAN SALES AGENCY WANTED: Met. eng., age 30. Would like to contact American manufacturer entering the Canadian field or one wishing a more vigorous coverage of present setup. Canadian, presently employed in Canada. Good background for this type of work. Box 6-110.

WELDING ENGINEER: Research, manufacturing, development and consultant exp. Age 33, married. Exp. all types of welding. Specialized in resistance welding, inert gas-arc welding, atomic hydrogen welding, manual and automatic operations on ferrous and high-temperature alloys. Supervisory exp. in manufacturing, engineering, inspection. Desires responsible position in eastern U.S. Box 6-115.

METALLURGICAL ENGINEER: Married, age 24. B.S. in met. eng. June 1947. Exp.—summer employment in steel plate mill and openhearth. 3½ yr. Air Corps officer. Desires permanent position with opportunity for advancement preferably in metal fabrication and heat treatment. Chicago area preferred but will accept a good opportunity anywhere. Available immediately. Box 6-120.

METALLURGIST: Age 28. B.Ch.E. Grad. study. 3 yr. exp. precious metal alloys. 5 yr. exp. ferrous metal processing, inspection and quality control, as naval ordnance officer. Desires position in met. control or sales. Prefers New York City area. Box 6-125.

METALLURGIST: Ex-naval officer. B.S. in met. 1942. Married, age 26. 2½ yr. diversified industrial exp. involving fdry., lab. and welding associated with stainless steels, air hardening steels, austenitic and martensitic irons. Prefers contact work and technical sales. Location immaterial. Box 6-130.

METALLURGIST: B.S. from M.I.T. 3 yr. openhearth and rolling mill chief observer. 2½ yr. casting and fabricating refractory and rarer metals, manufacturing ceramic products. Extensive contact work in stainless steels, supervision of high-alloy steel research. Extrusion, die-casting, forging, wire-drawing exp. Desires responsible production or development position. Box 6-135.

METALLURGIST: B.S. 1932. Age 38, married. 7 yr. exp. iron and steel research, metallography, plant control, physical testing, customer contacts. 7 yr. exp. ferrous and nonferrous met. with large manufacturer. Desires executive position in mfg. or fdry. Location immaterial. Box 6-140.

METALLURGICAL ENGINEER: B.S. and M.S. in met. eng. Age 31. 5 yr. as materials and process engineer in aircraft, tractor and farm implement fields; 2 yr. as asst. chief of lab. (aircraft); 1 yr. as research metallurgist. Desires responsible position as materials and process or met. eng. Location immaterial. Box 6-145.

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Boston Members of Quarter Century Club

Silver Certificates Commemorating 25 Years of Membership in A.S.M. Were Presented to Four Members of the Boston Chapter at the April Meeting. R. G. Sault (center), who headed the chapter during 1946-47, is holding a past chairman's certificate. Left to right are Harold D. Stuck of John W. Bolten & Sons, Inc.; E. L. Reed of Watertown Arsenal; Mr. Sault; V. O. Homerberg of Massachusetts Institute of Technology; and J. L. Faden, representing the 25-year sustaining membership of Boston Edison Co. (Photo by H. L. Phillips)

Course on Induction Heating

A basic sound slide course on radio frequency heating, of special interest to plant engineers, metallurgists, and technicians in heating fields, is now being offered by Westinghouse in a series of eight 2-hr. lecture units.

Included are a set of 15 slide films, records to match, 20 sets of review booklets, quiz questions, and an instructor's manual. Cost of the kit for 20 class members is $185. Further information regarding the course may be had from the Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa.

READER SERVICE COUPON

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Use this convenient method to obtain further information on items of interest to you in METALS REVIEW. The following numbers refer to the new products and manufacturers' literature in this issue.

THIS COUPON IS VOID AFTER SEPTEMBER 1, 1947

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